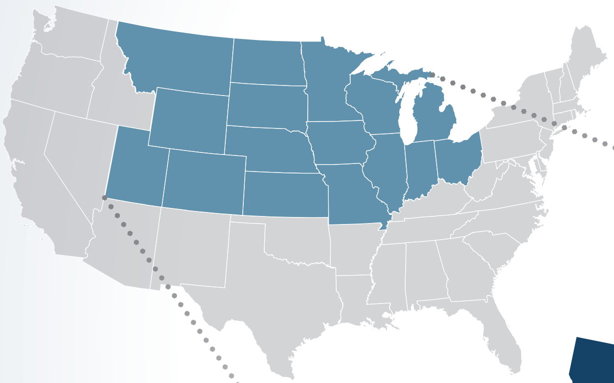
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 8 - CHAPTER 10



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First Responder Network Authority

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Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 8 - CHAPTER 10

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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 Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

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10. MISSOURI

American Indian tribes with a rich cultural history lived in what is now Missouri for centuries before the 1600s. The United States acquired present-day Missouri and several other states through the Louisiana Purchase in 1803. Missouri was established as a territory in 1812. In 1820, the Missouri territory became a state as part of the "Missouri Compromise," which admitted Missouri and Maine at the same time to avoid upsetting the balance of power between free and slave states (Missouri Office of the Secretary of State, 2014). Missouri is bordered by Iowa to the north; Nebraska, Kansas, and Oklahoma to the west; Illinois, Kentucky, and Tennessee to the east; and Arkansas to the south. This chapter provides details about the existing environment of Missouri as it relates to the Proposed Action.

General facts about Missouri are provided below:

- **State Nickname**: The Show Me State
- **Land Area:** 68,741.52 square miles; **U.S. Rank**: 21 (U.S. Census Bureau, 2016a)
- **Capital:** Jefferson City
- **Counties:** 115 (U.S. Census Bureau, 2015a)
- **2015 Estimated Population:** 6,083,672; **2014 U.S. Rank:**[1] 18 (U.S. Census Bureau, 2016a) (U.S. Census Bureau, 2016b)
- **Most Populated Cities:** Kansas City, St. Louis, Springfield, and Columbia (U.S. Census Bureau, 2015a)
- **Main Rivers:** Mississippi River, Missouri River, and Grand River (Maps of World, 2013)
- **Bordering Waterbodies:** Mississippi River and Missouri River (Maps of World, 2013)
- **Mountain Ranges:** Ozark Plateau and St. Francois Mountains (World Atlas, 2016)
- **Highest Point:** Taum Sauk Mountain (1,772 ft) (State of Missouri, 2015)

[1] 2015 data was not available when this PEIS was being developed.

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10.1. AFFECTED ENVIRONMENT

10.1.1. Infrastructure

10.1.1.1. *Definition of the Resource*

This section provides information on key Missouri infrastructure resources that could potentially be affected by FirstNet Proposed Actions. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as “developed.” Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports, harbors 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 10.1.1.3 provides an overview of the traffic and transportation infrastructure in Missouri, including road and rail networks and airport facilities. Missouri public safety infrastructure could include any infrastructure utilized by a public safety entity[2] as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (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 Missouri are presented in more detail in Section 10.1.1.4. Section 10.1.1.5 describes specific public safety communications infrastructure in Missouri. An overview of utilities in Missouri, such as power, water, and sewer, is presented in Section 10.1.1.6.

10.1.1.2. *Specific Regulatory Considerations*

Multiple Missouri laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 10.1.1-1 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.

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

Table 10.1.1-1: Relevant Missouri Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Missouri Revised Statutes (MRS): Title 11 Department of Public Safety	Missouri Department of Public Safety	Facilitates the preparation and implementation of emergency plans and emergency management programs and coordinates the implementation, upgrading, and maintenance of the state 9-1-1 system and dispatching system.
MRS: Title 15 Incorporation and Regulation of Certain Utilities and Carriers	Missouri Public Service Commission	Exercises jurisdiction and supervision over gas, electric, telecommunications, and water companies.
MRS: Title 7 Department of Transportation	Missouri Department of Transportation	Oversees the development and operation of the state's aviation, highway, bridge, rail, transit, and water port facilities and services and develops a transportation plan to enhance the state's infrastructure and economic development.
MRS: Title 7 Department of Transportation	Missouri Highway and Transportation Commission	Licenses, supervises, and regulates motor carriers; licenses motor carriers to transport hazardous waste, used oil, and infectious waste.

10.1.1.3. *Transportation*

This section describes the traffic and transportation infrastructure in Missouri, including specific information related to the road networks, airport facilities, and rail networks. 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 Missouri are based on a review of maps, aerial photography, and federal and state data sources.

The Missouri Department of Transportation (MoDOT) has jurisdiction over freeways and major roads, airports, railroads, mass transit, and river ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the MoDOT is to "provide a world-class transportation experience that delights our customers and promotes a prosperous Missouri" (MoDOT, 2013a).

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

- 131,900 miles of public roads (USDOT FHWA, 2014) and 24,385 bridges (USDOT FHWA, 2015a);
- 4,822 miles of rail network that includes passenger rail and freight (MoDOT, 2012a);
- 490 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- 14 public river ports (MoDOT, 2016).

Road Networks

As identified in Figure 10.1.1-1, the major urban centers of the state from north to south are Kansas City, Columbia, St. Louis, and Springfield (U.S. Census Bureau, 2013a). Missouri has nine 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, state, and county roads. Figure 10-1.1-1 illustrates and Table 10.1.1-2 lists the interstates and their start/end points in Missouri. 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 (USDOT FHWA, 2015b).

Table 10.1.1-2: Major Missouri Interstates

Interstate	Southern or western terminus in MO	Northern or eastern terminus in MO
I-29	I-70 in Kansas City	IA line in Rock Port
I-35	KS line in Kansas City	IA line near Blythedale
I-44	KS line in Joplin	I-70 in St. Louis
I-55	AR line near Holland	IL line in St. Louis
I-70	KS line in Kansas City	IL line in St. Louis

Source: (MoDOT, 2013b)

In addition to the Interstate System, Missouri has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (USDOT FHWA, 2013). Figure 10.1.1-1 illustrates the major transportation networks, including roadways, in Missouri. Section 10.1.8, Visual Resources, describes the National and State Scenic Byways found in Missouri from an aesthetic perspective.

National Scenic Byways are roads with nationwide interest; the byways are designated and managed by the U.S. Department of Transportation’s Federal Highway Administration. Missouri has two National Scenic Byways, Crowley’s Ridge Parkway and Great River Road (USDOT FHWA, 2015c).

State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by MoDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Missouri has 11 State Scenic Byways that crisscross the entire state, two of which—Great River Road and Crowley’s Ridge Parkway—are also designated as National Scenic Byways (Figure 10.1.1-1) (MoDOT, 2013c):[3]

- Historic Route 66
- Little Dixie Highway of the Great River Road
- Old Trails Road
- Cliff Drive
- Cliff Drive Connection
- Ozark Mountain Parkway
- Bloomfield Stars and Stripes Historical/Cultural Byway
- Show Me Santa Fe Trails
- Spirit of Kansas City
- Crowley’s Ridge Parkway
- Ozark Mountain High Road

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

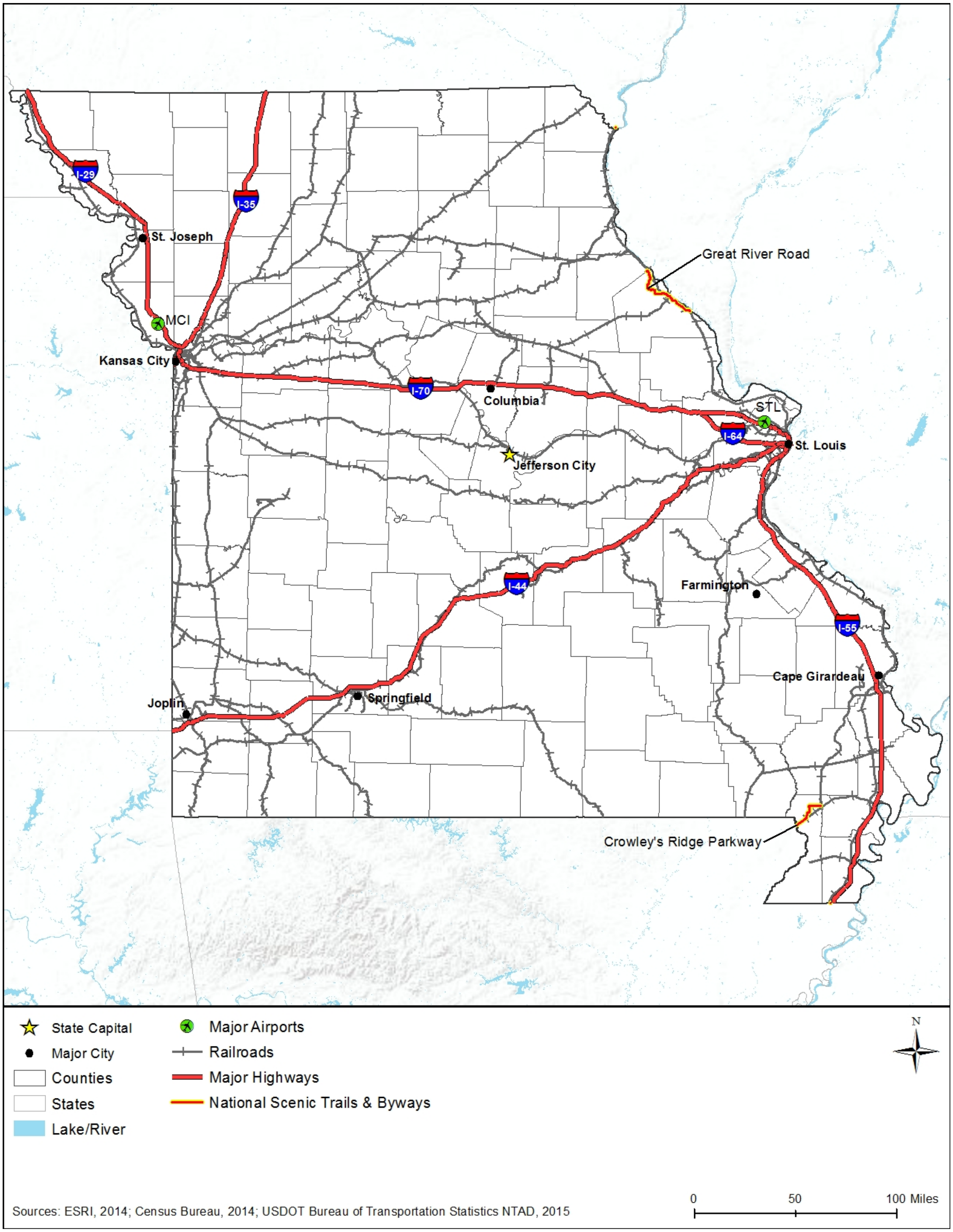

Figure 10.1.1-1: Missouri Transportation Networks

Airports

Two major international airports provide air service to the state.

- Lambert-St. Louis International Airport (STL) is located 11 miles northwest of downtown St. Louis. It is owned by the City of St. Louis and operated by the St. Louis Airport Authority (STL, 2015a). In 2014, STL served 12,384,015 passengers, facilitated 183,920 aircraft operations, and handled 129,979,113 pounds of cargo (STL, 2015b).
- Kansas City International Airport (MCI) is located 15 miles northwest of downtown Kansas City. It is owned by the City of Kansas City and operated by the Kansas City Aviation Department (MCI, 2015). In 2014, MCI served 10,166,879 passengers, facilitated 126,460 aircraft operations, and handled 187,804,858 pounds of freight (MCI, 2014).

Figure 10.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 10.1.7, Land Use, Recreation, and Airspace, provides greater detail on airports and airspace in Missouri.

Rail Networks

Missouri is connected to a rail network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. With 4,822 miles of track in the state, Missouri has the 10th longest rail network in the nation (MoDOT, 2012a). Figure 10.1.1-1 illustrates the major transportation networks, including rail lines, in Missouri.

Amtrak runs four lines through Missouri: Illinois Service, Missouri River Runner, Southwest Chief, and Texas Eagle. The Missouri River Runner is a regional service connecting St. Louis and Kansas City with two round trips per day (MoDOT, 2012b). The Illinois Service is another regional service connecting Chicago and St. Louis with multiple daily departures (Amtrak, 2015). The Southwest Chief and Texas Eagle are long-distance train routes that connect Chicago with Los Angeles and San Antonio, respectively. In fiscal year 2011, Amtrak served 492,793 passengers in Missouri (MoDOT, 2012b). Table 10.1.1-3 provides a complete list of Amtrak lines that run through Missouri.

Table 10.1.1-3: Amtrak Train Routes Serving Missouri

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Missouri
Illinois Service	Chicago, IL	St. Louis, MO	5 hours 30 minutes	St. Louis
Missouri River Runner	Kansas City, MO	St. Louis, MO	5 hours 40 minutes	Kansas City, Independence, Lee's Summit, Warrensburg, Sedalia, Jefferson City, Hermann, Washington, Kirkwood, St. Louis
Southwest Chief	Chicago, IL	Los Angeles, CA	40+ hours	La Plata, Kansas City
Texas Eagle	Chicago, IL	San Antonio, TX	32 hours 25 minutes	St. Louis, Poplar Bluff

Source: (Amtrak, 2015)

MetroLink is a light rail system in St. Louis. It operates on two lines that start in western St. Louis and run across the Mississippi River into East St. Louis, Illinois; the red line begins at

Lambert Airport Terminal 1 and the blue line starts at Shrewsbury-Lansdowne I-44 (Metro Transit, 2015). Both lines exit Missouri upon crossing the Mississippi River after the Laclede's Landing station (Metro Transit, 2015).

In 2012, 19 railroad companies operated in Missouri (MoDOT, 2012a). In 2011, freight rail companies carried 304 million tons of freight through Missouri, making it the fourth busiest in the nation, in terms of tons of freight moved (MoDOT, 2012a). Of the freight traveling via rail in Missouri in 2011, 19 million tons originated in the state and traveled to destinations outside its borders; at 18 percent, the largest commodity originating in the state were farm products (MoDOT, 2012a). In 2011, 65.7 million tons of freight terminated in Missouri; 81 percent of that cargo was coal (MoDOT, 2012a). In 2012, Kansas City was the second largest rail hub in the nation and St. Louis was the third largest rail hub (MoDOT, 2012a).

Harbors and Ports

Although Missouri is landlocked, the state has 1,050 miles of navigable rivers with 14 public river ports and over 200 private river ports (TranSystems, 2008). The Port of St. Louis is the third largest inland port in the U.S. (MoDOT, 2015). The majority of public and private river ports in the state are located on the Mississippi River (11 public and over 150 private); the Missouri River has 3 public river ports and over 50 private ports (TranSystems, 2008). On average, over $4.1 billion of cargo is transported annually in Missouri (MoDOT, 2015) (Missouri Port Authorities, 2016).

10.1.1.4. *Public Safety Services*

Missouri public safety services generally consist of public safety infrastructure and first responder personnel throughout the state. The general abundance and distribution of public safety services may roughly follow key state demographic indicators. Table 10.1.1-4 presents Missouri's key demographics including estimated population; land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 10.1.9, Socioeconomics.

Table 10.1.1-4: Key Missouri Indicators

Missouri Indicators	
Estimated Population (2015)	6,083,672
Land Area (square miles) (2010)	68,741.52
Population Density (persons per sq. mile) (2010)	87.1
Municipal Governments (2013)	952

Sources: (U.S. Census Bureau, 2016a) (National League of Cities 2007) (U.S. Census Bureau, 2013b)

Table 10.1.1-5 presents Missouri's public safety infrastructure, including fire and police stations. Table 10.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 10.1.1-5: Public Safety Infrastructure in Missouri by Type

Infrastructure Type	Number
Fire and Rescue Stations [a]	1,481
Law Enforcement Agencies [b]	576
Fire Departments [c]	772

[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.

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

Table 10.1.1-6: First Responder Personnel in Missouri by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	2,710
Fire and Rescue Personnel [b]	21,732
Law Enforcement Personnel [c]	22,484
Emergency Medical Technicians and Paramedics [d e]	6,140

[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.

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

10.1.1.5. *Telecommunications Resources*

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Missouri; 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 10.1.1-2 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.

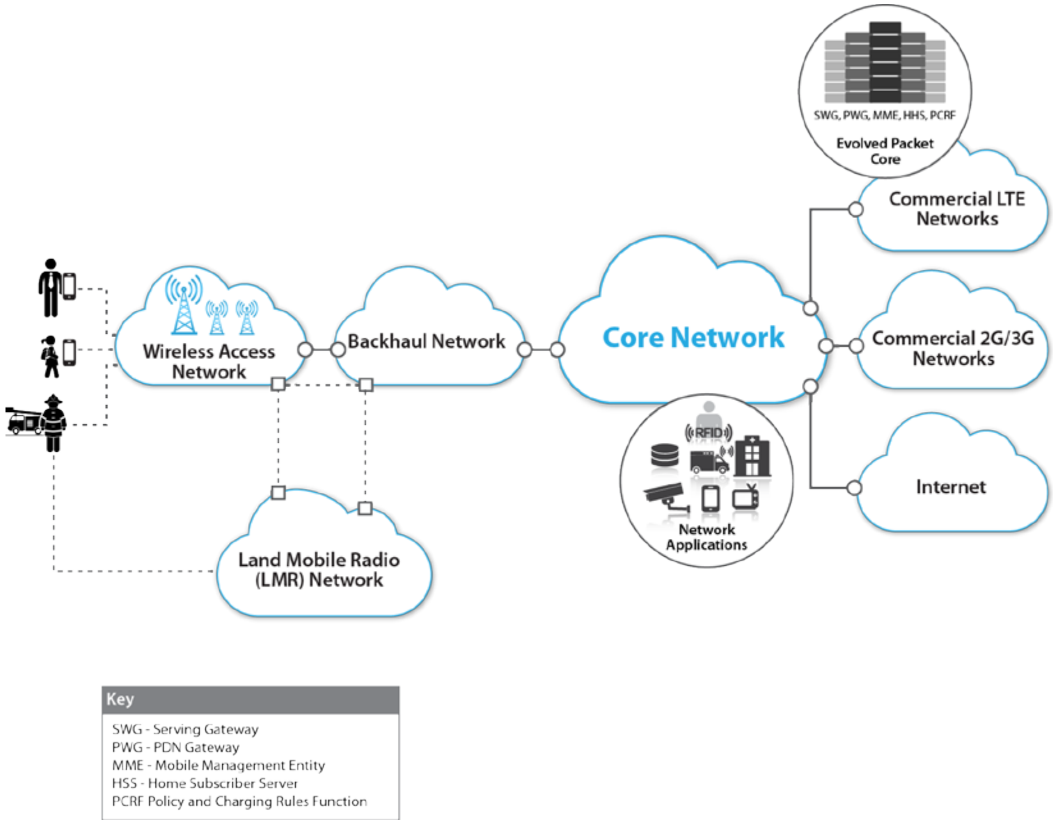

Figure 10.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

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 (NTFI, 2005).

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., including Missouri. 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) research and development roadmap to examine the current state of location-based technologies, 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 to better inform investment decisions (PSCR, 2015).

Like most states, Missouri's public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities. The state identified problems related to infrastructure, network gaps and coverage, and interoperability for their public safety communications (Missouri DPS, 2012a). The resulting statewide LMR network serving public safety users is the Missouri Statewide Interoperability Network (MOSWIN) which operates at Very High Frequency (VHF)[4] and 700 MHz (Missouri DPS, 2015a). MOSWIN planning, spectrum, interoperability coordination, and network operations is overseen by the Missouri Department of Public Safety (DPS).

Statewide/Multi-County Public Safety Networks

Missouri's MOSWIN is a five-channel, 84 tower network, operating primarily at VHF in addition to 700 MHz (Missouri DPS, 2015a). Figure 10.1.1-3 depicts the location of the MOSWIN tower network (Missouri DPS, 2015b).

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

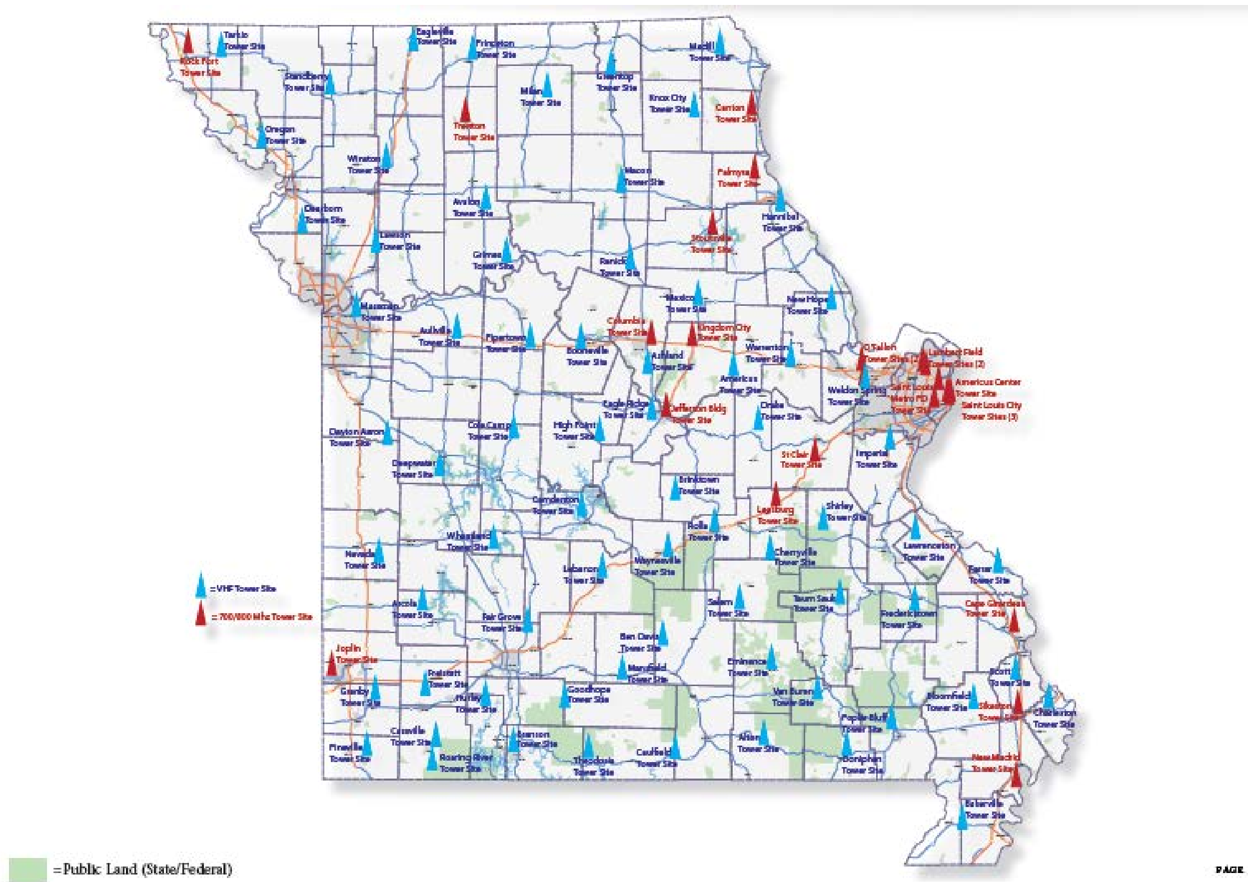

Figure 10.1.1-3: MOSWIN Tower Network

Source: (Missouri DPS, 2015a)

The MOSWIN network supports a diverse mix of public safety talk groups communication on VHF including the Missouri Highway Patrol, county sheriffs, and disaster response teams. In addition, the statewide MOSWIN network supports a number of state agencies and other user departments, including the Department of Natural Resources, Capitol Police, and the Department of Health and Senior Services (Missouri DPS, 2015b) (RadioReference.com, 2015a).

Interoperable communications in Missouri, as in most states, relies heavily on VHF for public safety cross-agency communications; as the Missouri DPS notes in its 2012 white paper, “Missouri’s use of VHF High Band public safety spectrum is widespread. Like many states, agencies across Missouri have depended on and implemented radio systems utilizing VHF High Band spectrum for their internal operations for decades and the Federal Communications Commission has acknowledged that by assigning multi-discipline interoperable channels in the public safety VHF High Band spectrum. Due to the availability of these resources, interoperable communications can be achieved by users” (Missouri DPS, 2012b).

The 700 MHz/800MHz Kansas City Metro Regional Radio System (MARRS) covers two states (Kansas and Missouri) with its digital Project 25 (P25)[5] network and provides coverage for two counties in Kansas (Wyandotte and Jackson) as well as three counties in Missouri (Jackson, Platt, and Clay) (Missouri DPS, 2015b) (RadioReference.com, 2015b).

City and County Public Safety Networks

The overwhelming majority of local city and county public safety systems in Missouri operate on analog VHF system (Missouri DPS, 2015a). In addition to the analog VHF public safety systems in Missouri, a number of counties and cities listed below in Table 10.1.1-7 operate on other frequencies including 700 MHz, 800 MHz, and Ultra High Frequency (UHF[6]) (Project 25.org, 2015a) (Project 25.org, 2015b).

Table 10.1.1-7: Missouri County and City P-25 Systems

Missouri P25 County/City Public Safety Systems	Frequency Band
Buchanan County Public Safety	800 MHz
Joint National Capital Region	UHF Lo
Joplin Public Safety	800 MHz
Kansas City Metro Regional Radio System	700 MHz/800MHz
St. Louis Area Trunked Emergency Radio-SLATER P25	800 MHz
St. Louis/Lambert Airport (P25)	700 MHz

Sources: (Project 25.org, 2015a) (Project 25.org, 2015b)

Public Safety Answering Points (PSAPs)

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 191 PSAPs in Missouri, serving Missouri's 114 counties and one independent city (St. Louis) (FCC, 2015a).

Commercial Telecommunications Infrastructure

Missouri's commercial telecommunications industry and infrastructure is robust with multiple service providers, offering products and services via the full spectrum of telecommunications technologies (FCC, 2016a) (FCC, 2014b). The following sub-sections present information on Missouri'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.

[5] Project-25 (P25) is a suite of standards for digital radio communications for use by federal, state, and local public safety agencies in North America to enable them to communicate with other agencies and mutual aid response teams in emergencies.

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

Carriers, Coverage, and Subscribers

Missouri'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 10.1.1-8 presents the number of providers of switched access[7] lines, Internet access,[8] and mobile wireless services including coverage.

Table 10.1.1-8: Telecommunications Access Providers and Coverage in Missouri (2013/2014)

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched Access Line[a]	162	97.6% of households
Internet Access[b]	126	47% of households
Mobile Wireless[c]	8	95% of population

[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] Internet access providers are presented in Table 21 in "Internet Access Services: Status as of December 31, 2013" by technology provided; number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers (FCC, 2014a).
[c] Mobile wireless provider data is provided by the FCC in the sources identified. However, NTIA's National Broadband Map provides newer data, so FirstNet is using NTIA's GIS-based data from the National Broadband Map instead of the data reported by the FCC. The process for retrieving the National Broadband Map data is explained in detail in a subsequent footnote in Section 10.1.1.5, Last Mile Fiber Assets.

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

Table 10.1.1-9 shows the wireless providers in Missouri along with their geographic coverage. The following four maps: Figure 10.1.1-4, Figure 10.1.1-5, Figure 10.1.1-6, and Figure 10.1.1-7 show the combined coverage for the top two providers, Sprint, T-Mobile, U.S. Cellular, Total Highspeed Internet Service, Radio Wire Inc., and Mark Twain Communications Company.[9] The

[7] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2013).

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

[9] 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 "Missouri Other Fiber Providers." All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as "Missouri Other Wireless Providers." Providers under 5% were denoted in their respective tables.

figure also shows the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 10.1.1-9: Wireless Telecommunications Coverage by Providers in Missouri

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	96.28%
Verizon Wireless	72.69%
Sprint	54.44%
U.S. Cellular	49.40%
T-Mobile	24.15%
Total Highspeed Internet Service	12.61%
Radio Wire, Inc.	6.09%
Mark Twain Communications Company	5.40%
Other[a]	43.08%

Prepared by: Booz Allen Hamilton

Source: (NTIA, 2014)

[a]Other: Provider with less than 5 percent coverage area. Providers include: I-Land Internet Services LLC; Cricket Wireless; Northwest Missouri Cellular; Missouri Wi-Fi; Big River Telephone, LLC; KC Coyote; Air Link; Mid-States Services, LLC; Blue Mule Wireless; ProTronics Technologies, Inc.; Brown Dog Networks; STLWiMax; Easy Net; MCM Systems; Lathrop Telephone Company; ULink LLC; BPS Networks; Wisper ISP Inc.; IAMO Wireless; United Services, Inc.; YHTI; American Wireless Inc.; Haug Communications; Grand River Mutual Telephone Corp.; Ozark Computers; Steelville Telephone Exchange, Inc.; Alsat Wireless; Stouffer Communications; KTIS; Subsidiary of Rock Port Telephone; Invisalink; Valnet; Thunderbolt Broadband Co.; Video Direct; Adams Networks; MyChoice; WIFI Midwest, Inc.; CTC Wireless Internet; Wyerless, LLC; Green Hills Technologies; Chariton Valley Telecom Corp.; Bay's Internet; Rural iNet; Rock Port Cablevision; Holway Telephone Company; Carthage Water & Electric; Lexsar Solutions, Inc.; Northeast Missouri Rural Telephone Company; Le-Ru Telephone Company; LTO Communications, LLC.

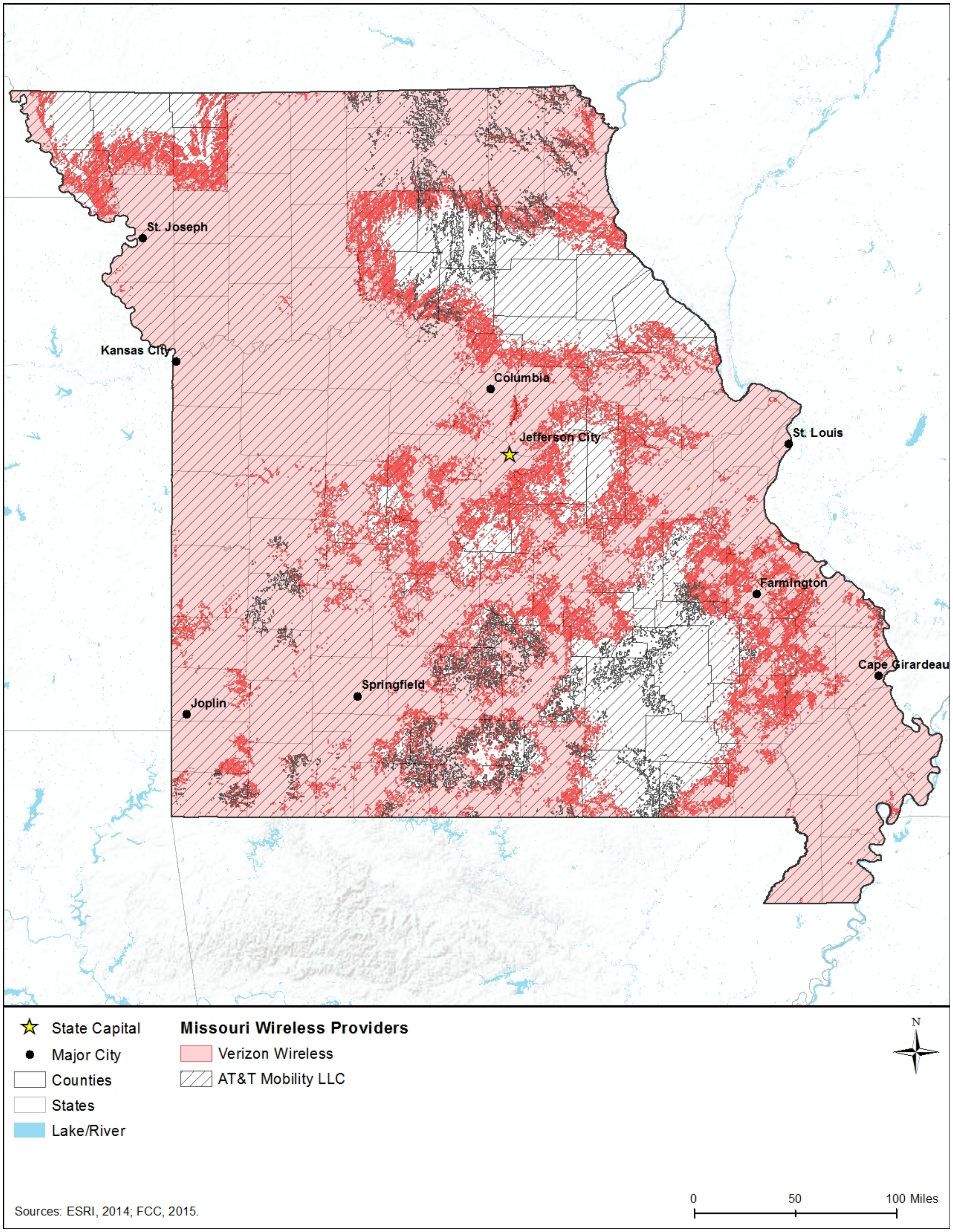

Figure 10.1.1-4: Top Wireless Providers Availability in Missouri

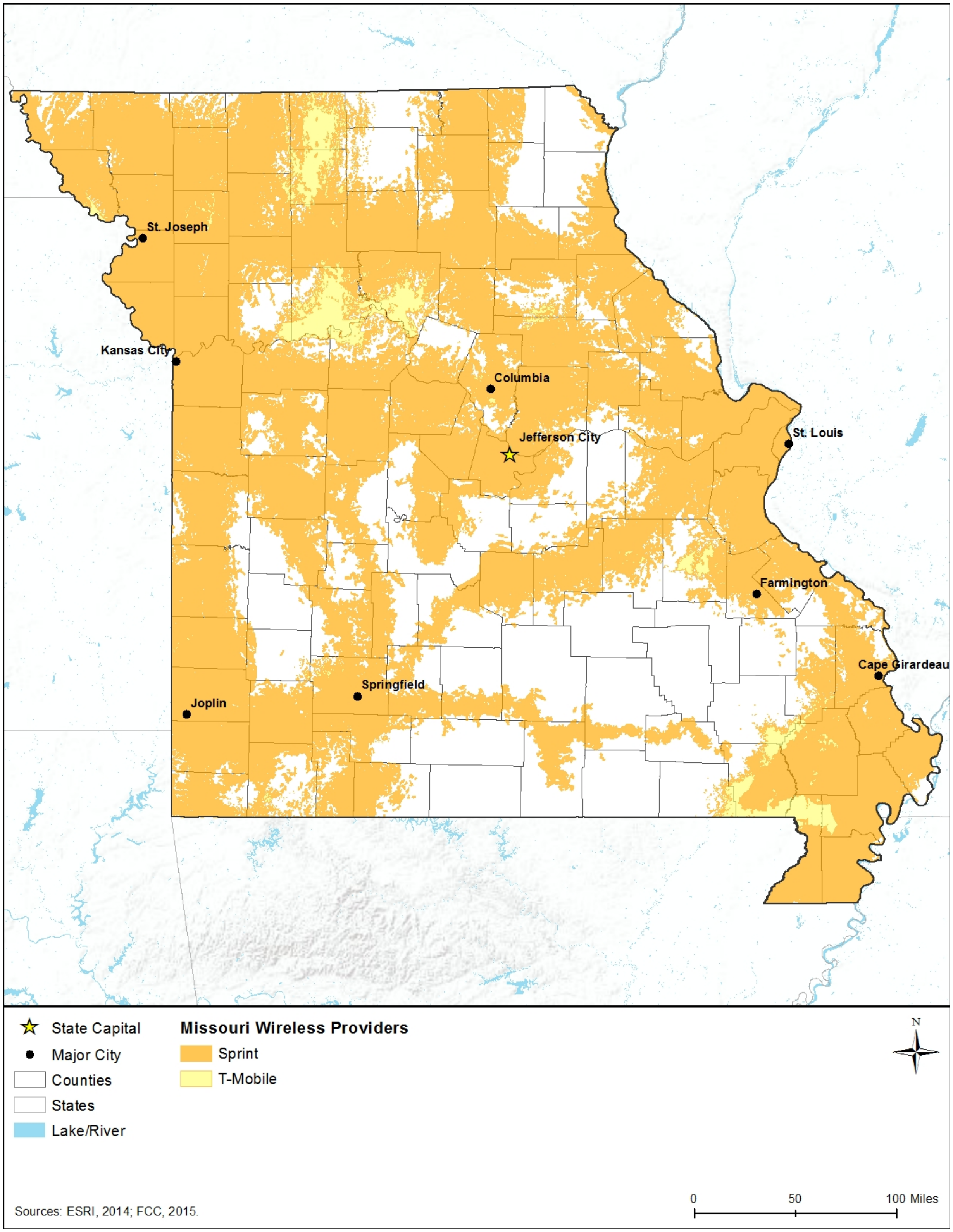

Figure 10.1.1-5: Sprint and T-Mobile Wireless Availability in Missouri

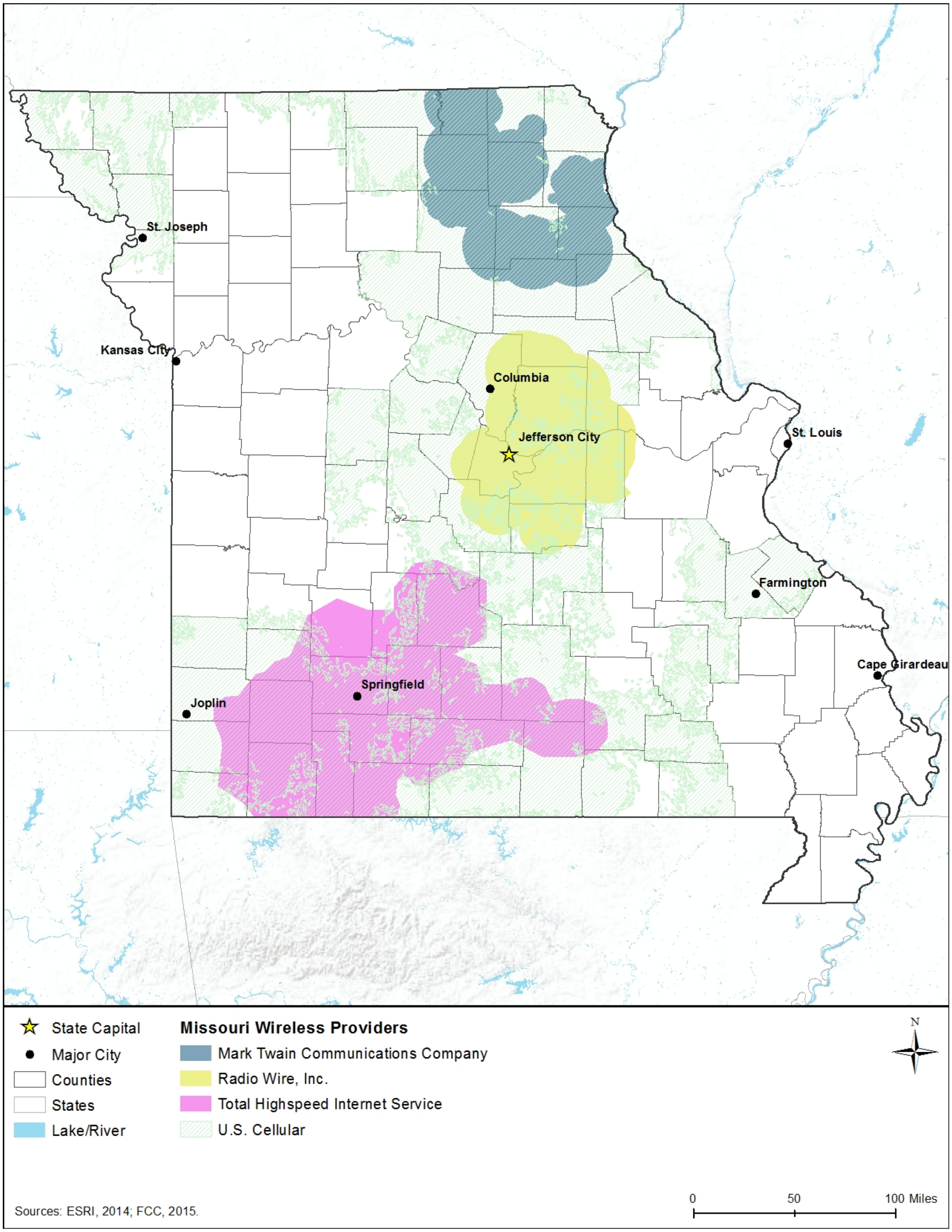

Figure 10.1.1-6: Mark Twain Communications Company, Radio Wire Inc., Total Highspeed Internet Service, and U.S. Cellular Wireless Availability in Missouri

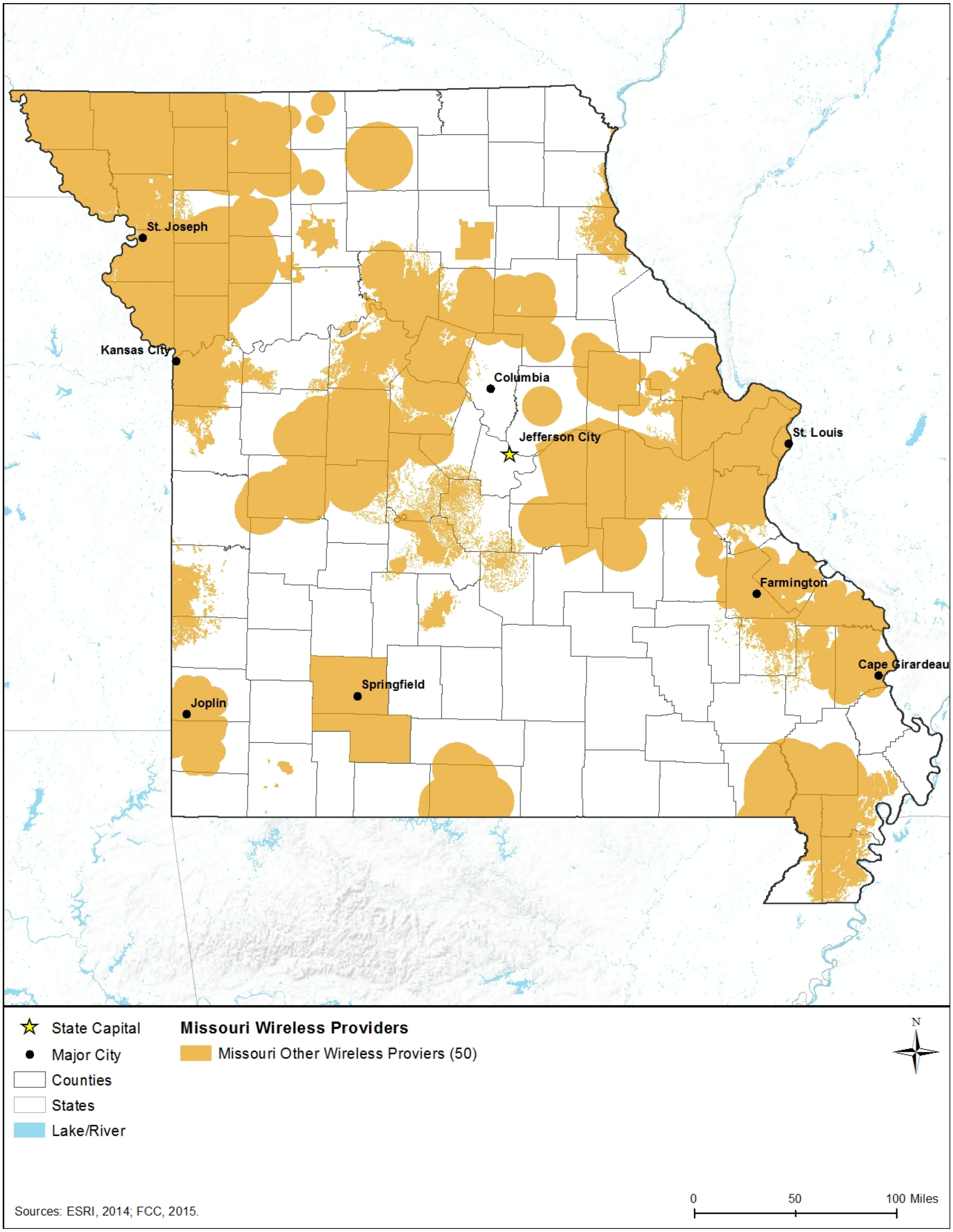

Figure 10.1.1-7: Other Providers Wireless Availability in Missouri

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 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 10.1.1-8 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/

Figure 10.1.1-8: Types of Towers

Telecommunications tower infrastructure proliferates throughout Missouri, although tower infrastructure is concentrated in the higher and more densely populated areas of Missouri; St. Joseph's, Kansas City, Columbia, St. Louis, Jefferson City, Joplin, Springfield, Farmington, and Cape Girardeau. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC.[10] Table 10.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Missouri by tower type, and Figure 10.1.1-9 presents the location of those structures, as of June 2016.

Table 10.1.1-10: Number of Commercial Towers in Missouri by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	569	100ft and over	0
75ft – 100ft	959	75ft – 100ft	1
50ft – 75ft	621	50ft – 75ft	25
25ft – 50ft	422	25ft – 50ft	46
25ft and below	93	25ft and below	2
Subtotal	**2,664**	**Subtotal**	**74**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	96	100ft and over	2
75ft – 100ft	70	75ft – 100ft	2
50ft – 75ft	21	50ft – 75ft	1
25ft – 50ft	3	25ft – 50ft	2
25ft and below	0	25ft and below	0
Subtotal	**190**	**Subtotal**	**7**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	43	100ft and over	1
75ft – 100ft	150	75ft – 100ft	1
50ft – 75ft	79	50ft – 75ft	3
25ft – 50ft	25	25ft – 50ft	0
25ft and below	9	25ft and below	0
Subtotal	**306**	**Subtotal**	**5**
Constructed Tanks[d]			
Tanks	22		
Subtotal	**22**		
Total All Tower Structures		**3,268**	

Source: (FCC, 2015b)

[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, 2015b).
[b] Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).
[c] Multiple constructed structures per antenna registration (FCC, 2016b).
[d] Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016b).

[10] An antenna structure must be registered with the FCC if the antenna structure is taller than 200 feet aboveground level or may interfere with the flight path of a nearby airport.

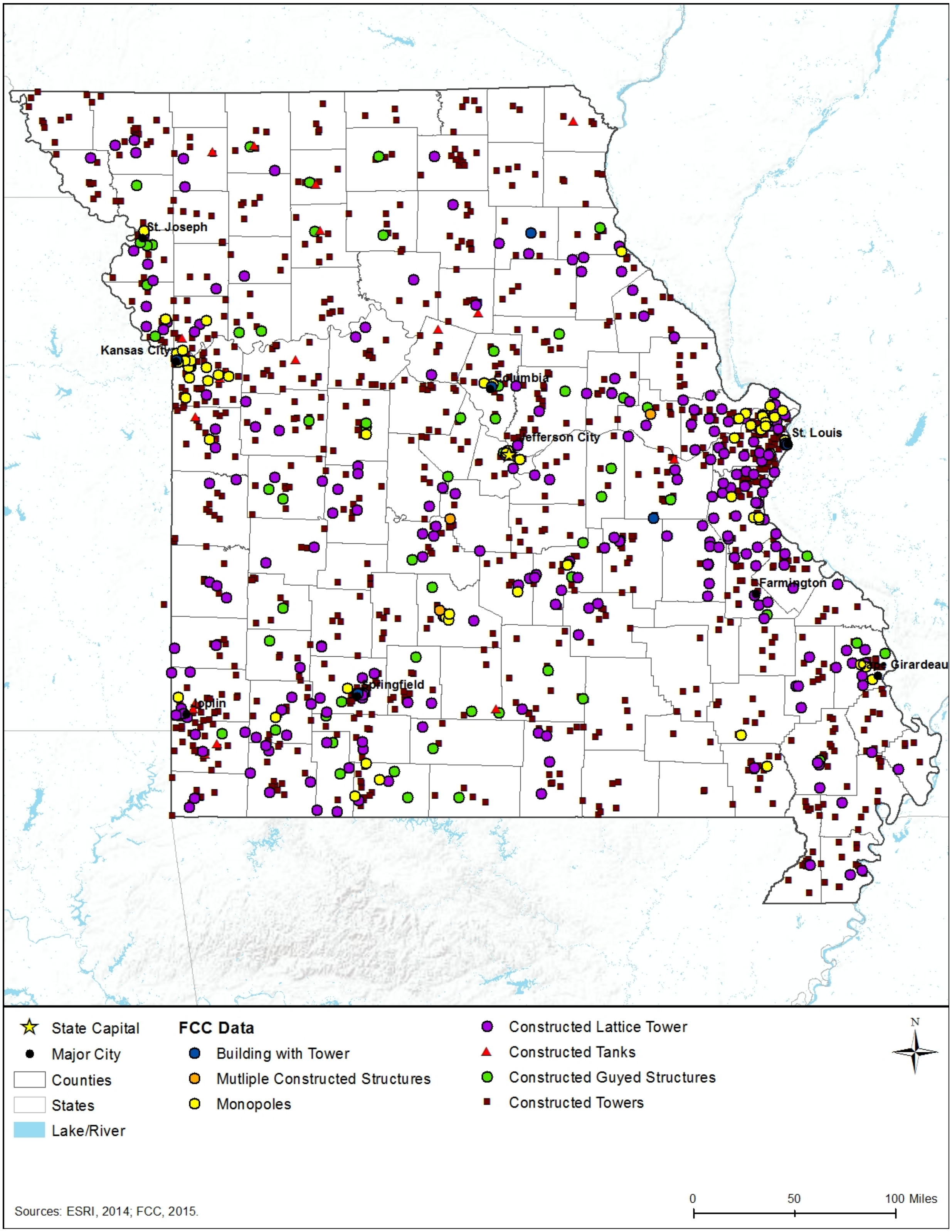

Figure 10.1.1-9: FCC Tower Structure Locations in Missouri

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. 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 10.1.1-10. 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).

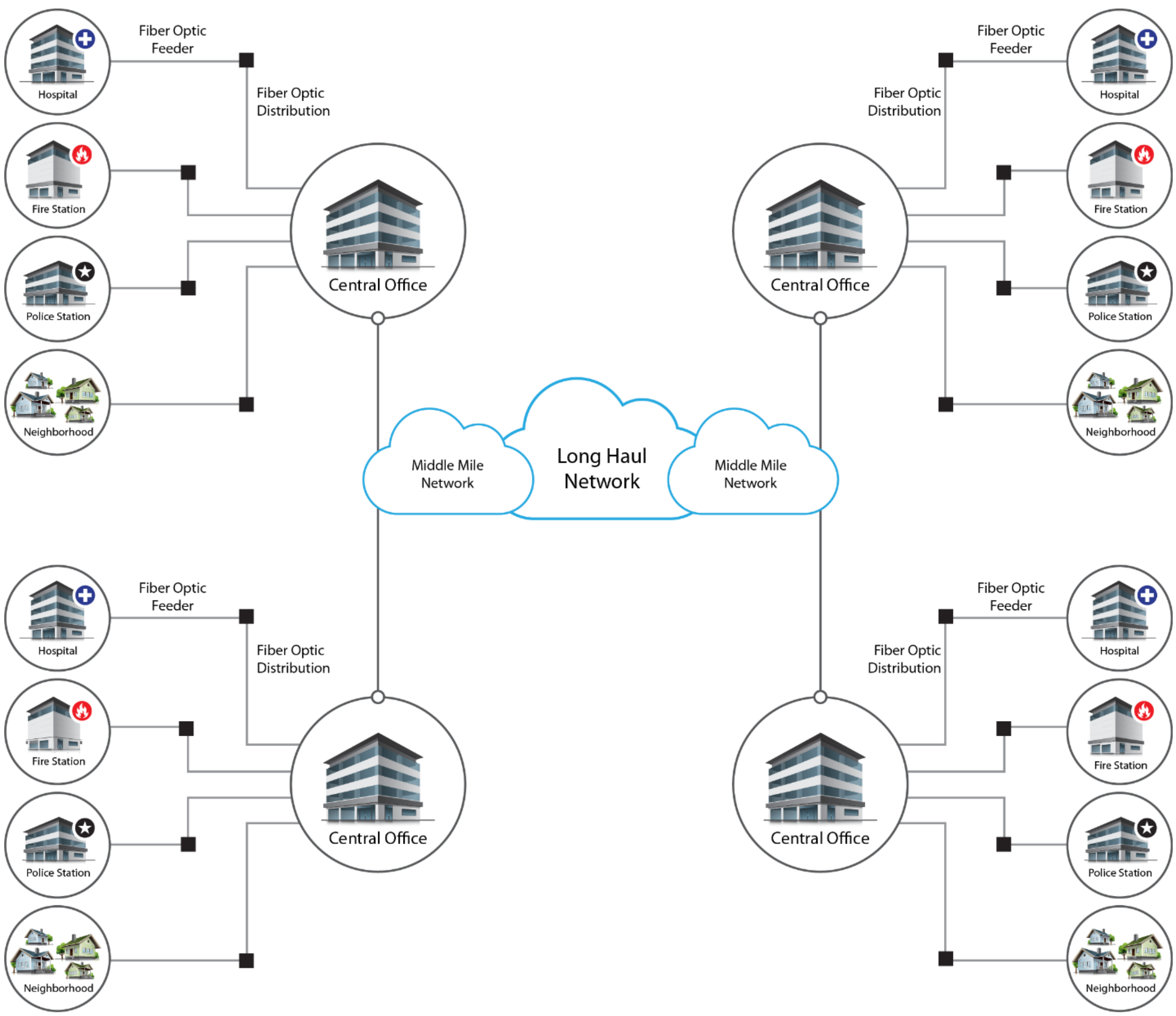

Figure 10.1.1-10: Typical Fiber Optic Network in Missouri

Prepared by: Booz Allen Hamilton

Source: (ITU-T, 2012)

Last Mile Fiber Assets

In Missouri, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Missouri there are 23 fiber providers that offer service in the state. Figure 10.1.1-11 shows coverage for CenturyLink and AT&T Southwest; Figure 10.1.1-12 shows the coverage for providers with less than five percent coverage area, respectively.

Table 10.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
CenturyLink	12.25%
AT&T Southwest	6.71%
Other[a]	31.42%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Zayo Group, LLC; Cogent Communications, Inc.; Windstream Iowa Communications, Inc.; liNKCity; TW Telecom; Citizens Cablevision, Inc.; Google Fiber; City Light Gas & Water Office; Subsidiary of Rock Port Telephone; Green Hills Telecommunications Services; Farber Telephone Company; Marshall Municipal Utilities; YHTI; N. W. Communications; New Florence Telephone Company, Inc.; Level 3 Communications, LLC; Choctaw Telephone Co.; Alma Telephone Company; Ozark Telephone Company; Peace Valley Telephone Co., Inc.; MoKan Dial, Inc.; City of Poplar Bluff; Lathrop Telephone Company; Zito Media; Socket Telecom, LLC; SpringNet; Seneca Telephone Company; Miller Telephone Company; Boycom Cablevision, Inc.; Goodman Telephone Company, Inc.; Rock Port Cablevision; Holway Telephone Company; McDonald County Telephone Co; Granby Telephone Company; Oregon Farmers Mutual Telephone Company; Cable America Missouri, LLC; Le-Ru Telephone Company; BPS Telephone Company; Citizens Telephone Company of Higginsville, Missouri; TDS Telecom; New Wave Communications; Cable ONE; Comcast; Ellington Telephone Company; IAMO Telephone Company; KLM Telephone Company; Big River Telephone, LLC; Steelville Telephone Exchange, Inc.; Craw-Kan Telephone; Time Warner Cable; KTIS; Ralls Technologies; Suddenlink Communications; FairPoint Communications; Otelco Mid-Missouri LLC; Fidelity Communications Company; Green Hills Telephone ILEC; Co-Mo Connect; Mark Twain Rural Telephone Company; ProTronics Technologies, Inc.; Northeast Missouri Rural Telephone Company; Chariton Valley Telecom Corporation; MegaPath Corporation; MCC Missouri LLC; Windstream Missouri, Inc.; Grand River Mutual Telephone Corp.; Charter Communications, Inc.

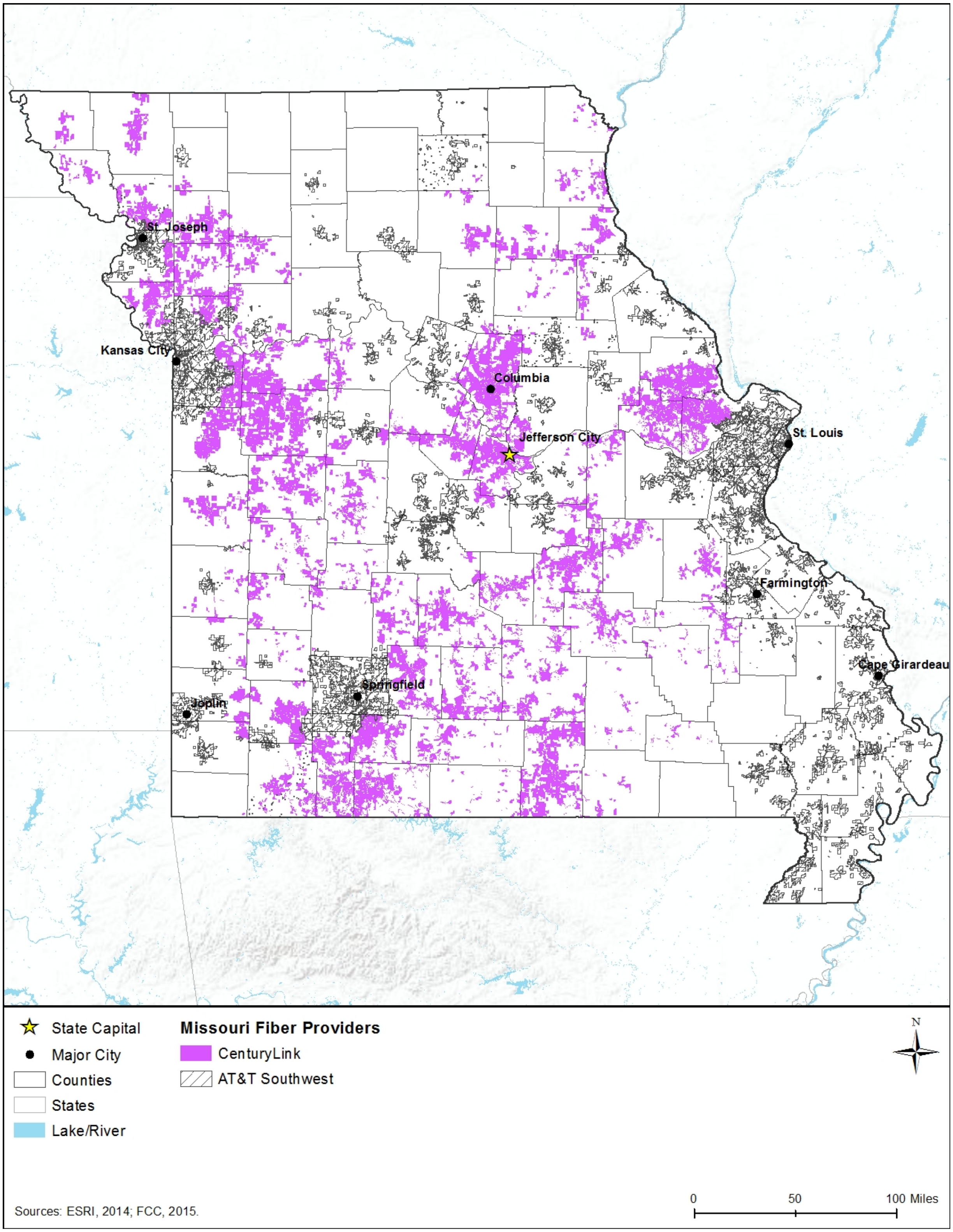

Figure 10.1.1-11: Fiber Availability in Missouri for AT&T and CenturyLink

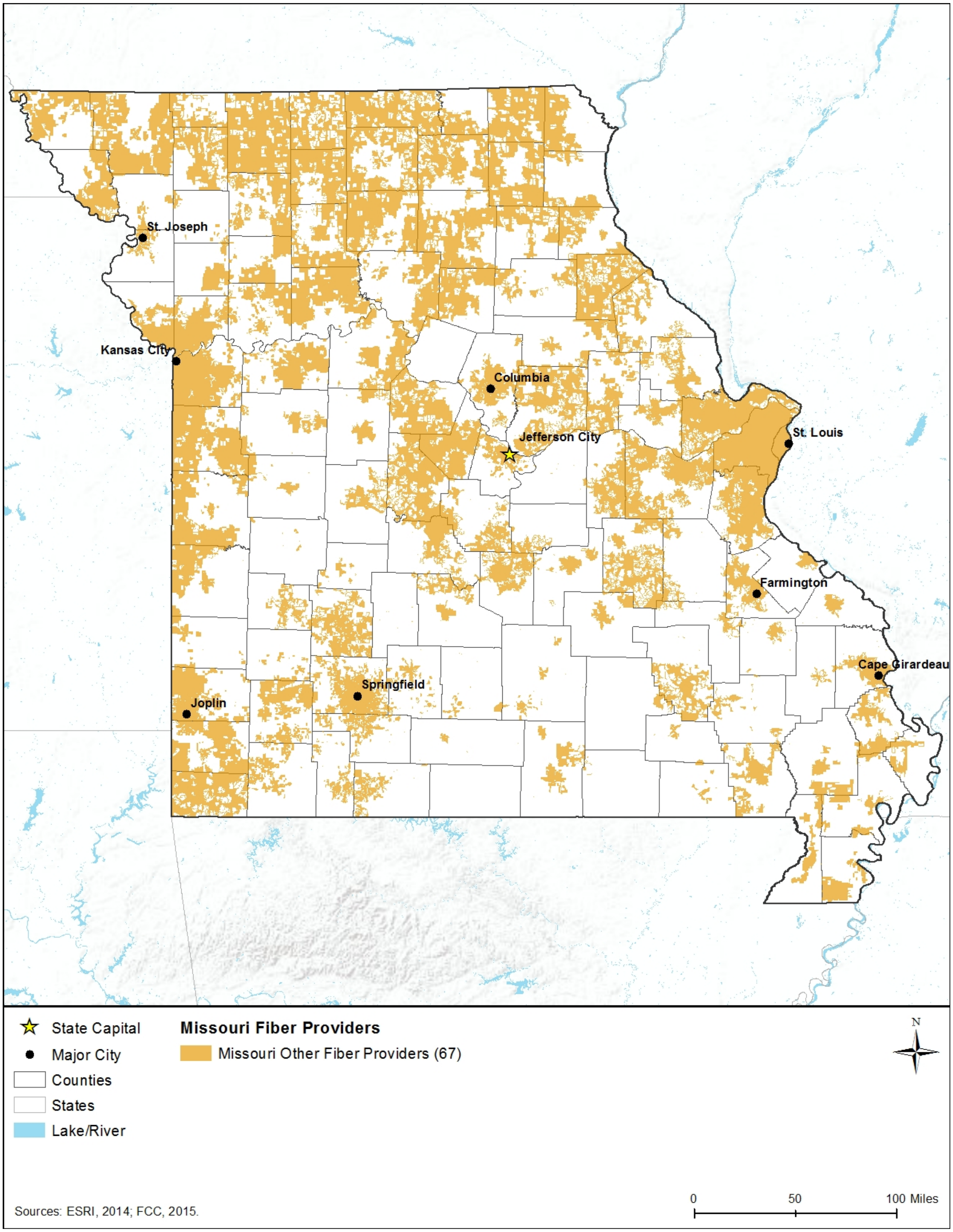

Figure 10.1.1-12: Other Provider's Fiber Availability in Missouri

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 and 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.

10.1.1.6. *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 10.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Electric utilities in Missouri are regulated by the Missouri Public Service Commission (PSC), which oversees the rates and reliability of service for investor owned utilities, as well as the operational safety for rural electric cooperatives (PSC, 2015a). Three investor owned utilities nofall under the jurisdiction of the PSC: Ameren Missouri, Empire District Electric Company, and Kansas City Power and Light (PSC, 2015b).

Nearly all of the state's electricity comes from generation plants using coal as a fuel source (EIA, 2015a). In 2014, coal-fueled electric generation plants produced 72,409,212 megawatt hours[11] of power, about 82 percent of the total 87,834,468 megawatt hours generated in Missouri. Nuclear power facilities provided 9,276,356 megawatt hours, about 11 percent of the total. Natural gas and wind power accounted for 4.5 percent and 1 percent, respectively; while petroleum liquids, hydroelectric facilities, and biomass all provided negligible amounts of electricity. Coal has been the primary source of power in the state for years, since at least 1990 (EIA, 2015a). In fact, "Missouri was the first state west of the Mississippi River to produce coal commercially" (EIA, 2015b). All of the nuclear power comes from the Callaway Nuclear Generating Station, the states' only nuclear facility. Both the transportation and residential sectors of the state used 29 percent of the state's electricity in 2013, while the commercial sector used 22 percent, and the industrial sector used approximately 20 percent (EIA, 2015b).

Water

Investor owned water utilities have some aspects of their operation overseen by the Missouri PSC; namely their rates and the quality of their service (PSC, 2015a). Four such utilities fall

[11] One megawatt hour is defined as one thousand kilowatt-hours or 1 million watt-hours; 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, 2015e)

under PSC jurisdiction: Liberty Utilities, Empire District, Missouri-American Water and Raytown Water Company (PSC, 2015c). Public water systems are overseen by the Public Drinking Water Branch of the Missouri Department of Natural Resources (DNR). This regulation extends to monitoring contaminants in water, issuing permits for water system operation, and providing technical and financial support (MDNR, 2015a). A public water system is one that "provides water through piping or other constructed conveyances for human consumption to at least 15 service connections, or serves an average of at least 25 people for at least 60 days each year" (MDNR, 2014a). In 2014, the state had 2,722 such systems, which are divided into three categories: community, non-transient non-community, and transient non-community. Community systems are largely residential, such as towns, subdivisions, or nursing homes. Non-transient non-community systems serve the same people on a regular basis, but are not residential; this category includes schools or workplaces. Transient non-community systems serve a variety of people on an ever changing basis, such as rest stops or restaurants. Community systems account for 53 percent of all systems in the state, while non-transient non-community systems and transient non-community account for 0.08 and 39 percent, respectively. Most of the state's population gets their water from the Missouri River (43 percent of the population) or groundwater sources (40 percent of the population). The Mississippi River supplies water for 0.6 percent of the state, while other surface waters contribute water for 16.8 percent of the state's population (MDNR, 2014a). Community water systems are required to submit a yearly report to their customers detailing information about their water. These Consumer Confidence Reports (CCR) include information on the source of the customer's drinking water, an explanation of how susceptible the source is to contamination, descriptions of contaminants that were found, and compliance with other drinking water rules or regulations (MDNR, 2015b).

Wastewater

The management of wastewater in Missouri is handled through the use of permits and certifications. The Missouri DNR Water Protection Program issues National Pollutant Discharge Elimination System (NPDES) permits for the discharge of treated wastewaters, as well as land application of wastes from facilities, including agricultural facilities. The issued permits specify the amounts and types of pollutants that may be discharged (MDNR, 2015c). NPDES permits are split into two categories: general and site-specific. General permits can be used for a number of locations whose needs are similar; any facility or program operating under a general permit must adhere to the general regulations it sets forth. This could include permits for "Composting operations under 20 acres composed of feedstocks from agricultural, wood and food product sources. The operation is to be designed and operated as a no-discharge facility" (MDNR, 2015d). To contrast this, a site specific permit is unique to the discharger and the receiving water (MDNR, 2015c). An example of this would include the permit for the operation of the Foster South Mine, which is approved to discharge 1.29 million gallons per day into the New Home Creek (MDNR, 2015e).

While wastewater treatment facilities must be permitted through the DNR, their operators of must also be certified for facility operation. This requires proof that an operator has met all educational requirements set forth by the DNR and passed a wastewater facility operator exam. Different levels of certifications are offered by the DNR, which correspond with classes of wastewater treatment facilities. Facilities are categorized by the types of pollutants they discharge, as well as the size of the populations they serve (MDNR, 1998).

Solid Waste Management

The management of Missouri's solid waste is handled by the DNR to manage permitting of solid waste management facilities as well as the monitoring and enforcement of regulations set forth by the state and federal governments. Landfilling remains a primary solution for the disposal of waste products, though other options are available (MDNR, 2015f). In total, the state is home to 33 landfills, of which 18 are designated for the disposal of sanitary waste. Nine of these facilities handle utility wastes, while two serve as construction and demolition landfills, three handle infectious waste, and one facility is designed for the disposal of special wastes (MDNR, 2014b). Missouri also has five material recovery facilities and one composting facility (MDNR, 2015g).

The DNR conducts studies on the composition of its solid waste, with the most recent study being completed in 2008. This study indicated that the state's 15 non-sanitary landfills (municipal/utility waste, construction/demolition waste, industrial waste, other waste) accepted 67,359 tons of material. Municipal waste made up 58.3 percent of this amount, while special waste and demolition waste accounted for 13.5 percent and 13.2 percent respectively. Industrial waste contributed a further 10.7 percent (MDNR, 2009a). The DNR has set a goal of reducing the waste sent to landfills by 40 percent to be accomplished through recycling and reuse efforts (MDNR, 2015h).

10.1.2. Soils

10.1.2.1. *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." (NRCS, 2015b)

(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." (NRCS, 2015b)

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.

10.1.2.2. *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 Section 1.8, Overview of Relevant Federal Laws and Executive Orders. A list of applicable state laws and regulations is included in Table 10.1.2-1 below.

Table 10.1.2-1: Relevant Missouri Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Missouri Stormwater Regulations (10 Code of State Regulations [CSR] 20-6.200)	Missouri Department of Natural Resources	A stormwater permit and erosion controls are required for any land disturbance one or more acres in size.

10.1.2.3. *Environmental Setting*

Missouri is composed of four Land Resource Regions (LRR),[12] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Feed Grains and Livestock Region,
- 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 Missouri's four LRRs are 12 Major Land Resource Areas (MLRA),[13] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Missouri's MLRAs are presented in Figure 10.1.2-1 and Table 10.1.2-2.

[12] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).

[13] 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" (NRCS, 2006).

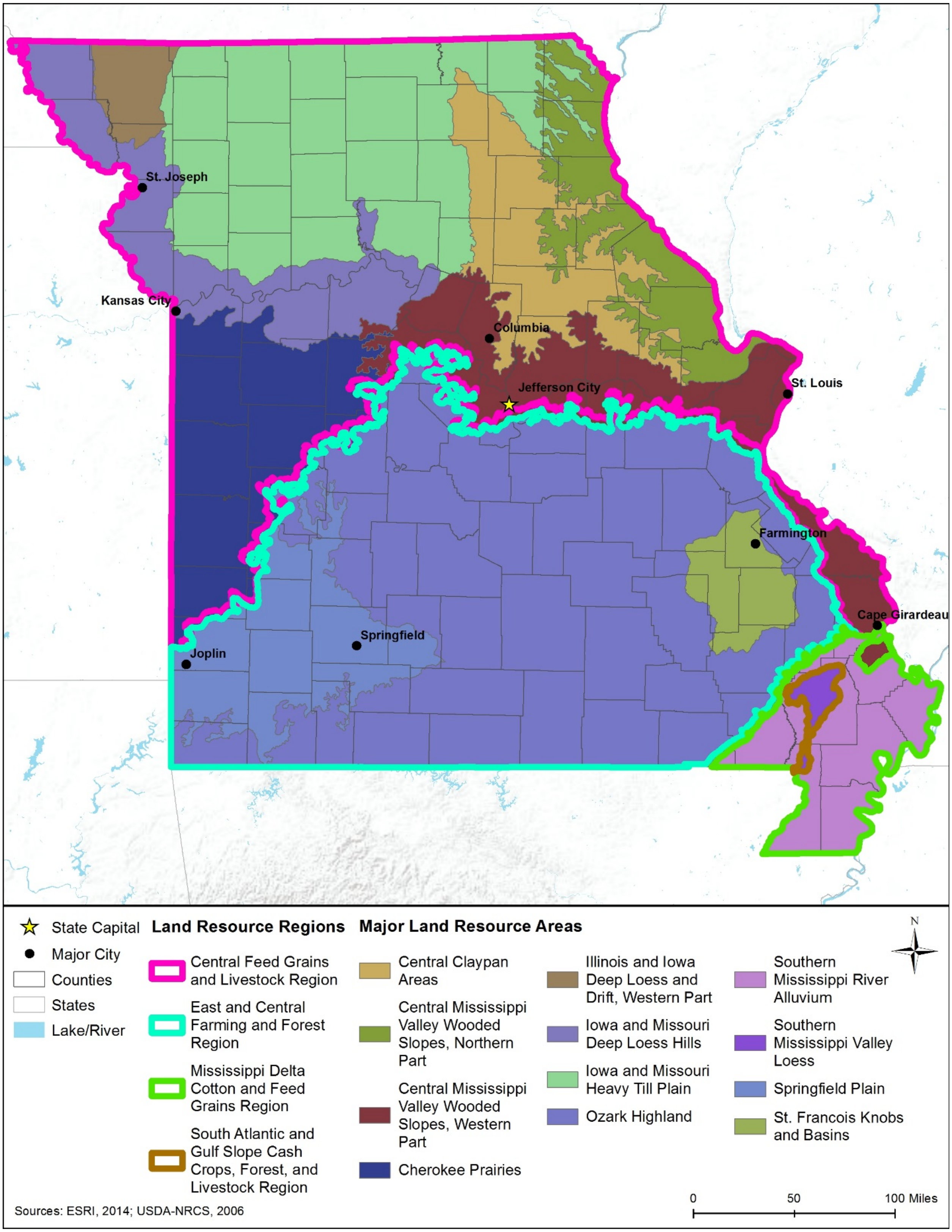

Figure 10.1.2-1: Locations of Major Land Resource Areas in Missouri

Table 10.1.2-2: Characteristics of Major Land Resource Areas in Missouri

LMRA Name	Region of State	Soil Characteristics
Central Claypan Areas	Northeastern Missouri	Alfisols[a] is the dominant soil order. These loamy[b] or clayey soils range from well drained to poorly drained and are typically very deep.
Central Mississippi Valley Wooded Slopes, Northern Part	Northeastern Missouri	Alfisols, Entisols,[c] Inceptisols,[d] and Mollisols[e] are the dominant soil orders. These soils range from excessively drained to poorly drained, and from very deep to very shallow. They are loamy, clayey, or silty.
Central Mississippi Valley Wooded Slopes, Western Part	Central Missouri	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These soils range from excessively drained to poorly drained, and from very deep to very shallow. They are loamy, clayey, or silty.
Cherokee Prairies	Western Missouri	Alfisols and Mollisols are the dominant soil orders, with Vertisols[f] less so. These moderately deep to very deep soils are clayey or loamy, and range from poorly drained to well drained.
Illinois and Iowa Deep Loess and Drift, Western Part	Northwestern Missouri	Alfisols and Mollisols are the dominant soil order, with Entisols less so. These loamy, silty, or clayey soils range from poorly drained to well drained, and are very deep.
Iowa and Missouri Deep Loess Hills	Northwestern Missouri	Mollisols is the dominant soil order, with Alfisols and Entisols less so. These loamy or silty soils are typically moderately well drained to well drained, and are very deep.
Iowa and Missouri Heavy Till Plain	Northern Missouri	Alfisols and Mollisols are the dominant soil orders. These soils range from poorly drained to well drained and are typically very deep. They are clayey or loamy.
Ozark Highland	Southern Missouri	Alfisols and Ultisols[g] are the dominant soil orders. These soils are moderately well drained to excessively drained and range from shallow to very deep.
Southern Mississippi River Alluvium	Southeastern Missouri	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 Valley Loess	Southeastern Missouri	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.
Springfield Plain	Southwestern Missouri	Alfisols, Mollisols, and Ultisols are the dominant soil orders. These soils are moderately well drained to well drained, and are moderately deep to very deep. They are medium to fine textured.
St. Francois Knobs and Basins	Southeastern Missouri	Alfisols and Ultisols are the dominant soil orders. These moderately well drained to excessively drained soils range from shallow to very deep, and are moderately coarse textured to fine textured.

[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.” (NRCS, 2015d)
[b] Loamy Soil: “[A soil] that combines [sand, silt, and clay] in relatively equal amounts.” (Purdue University Consumer Horticulture, 2006)
[c] 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 percent of the world's ice-free land surface.” (NRCS, 2015d)
[d] 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.” (NRCS, 2015d)

[e] Mollisols: "Soils that have a dark colored surface horizon relatively high in content of organic matter. They are base rich throughout and quite fertile. Mollisols form under grass in climates that have a moderate to pronounced seasonal moisture deficit." (NRCS, 2015d)
[f] 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." (NRCS, 2015d)
[g] 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." (NRCS, 2015d)
Source: (NRCS, 2006)

Soil characteristics are an important consideration for FirstNet insomuch 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 biota[14] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[15] 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 rutting[16] (discussed further in the subsections below).

10.1.2.4. *Soil Suborders*

Soil suborders are part of the soil taxonomy. [17] Soil orders are the highest level in the taxonomy; there are 12 soil orders in the world and they are characterized by both observed and inferred[18] 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 (NRCS, 2015e). The STATSGO2[19] soil database identifies 13 different soil suborders in Missouri (NRCS, 2015a). Figure 10.1.2-2 depicts the distribution of the soil suborders, and Table 10.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[14] The flora and fauna of a region.

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

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

[17] Taxonomy: "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2013b)

[18] "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.)" (NRCS, 2015g)

[19] 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.

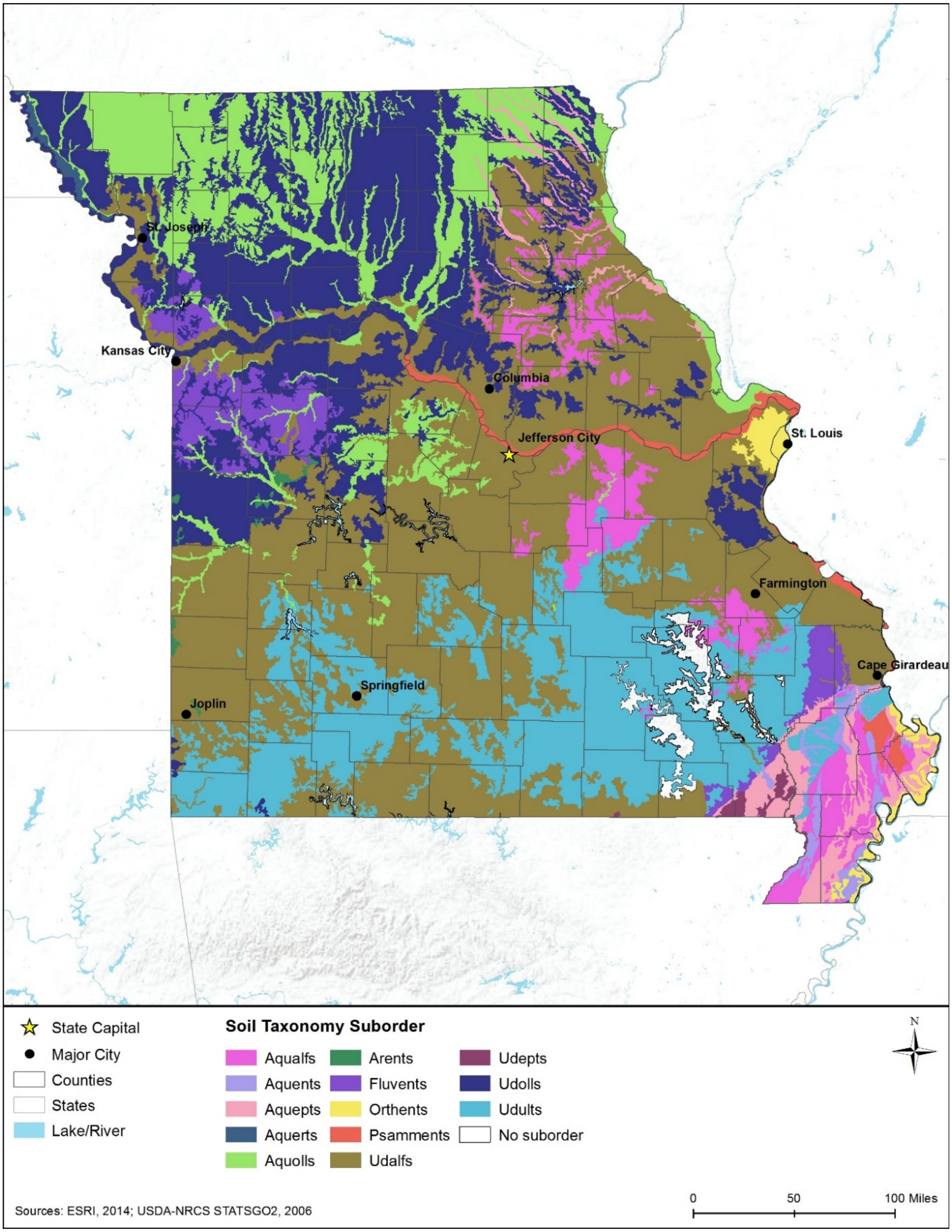

Figure 10.1.2-2: Missouri Soil Taxonomy Suborders

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Table 10.1.2-3: Major Characteristics of Soil Suborders[20] Found in Missouri, as depicted in Figure 10.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[a]	Hydrologic Group	Runoff Potential	Permeability[b]	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.	Silt loam, Silty clay	0-5	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
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.	Loamy sand, Silt loam, Silty clay loam	0-2	Poorly drained to somewhat poorly drained	No, Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Clay, Silty clay loam	0-2	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	0-2	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Clay, Clay loam, Silt loam, Silty clay, Silty clay loam	0-9	Poorly drained to somewhat poorly 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
Entisols	Arents	Arents are predominantly used for pasture, crops, wildlife habitat, and urban land. Since they have been subject to various means of mixing, they lack diagnostic horizons.	Very gravelly clay loam	5-50	Well drained	No	C	Medium	Low	Medium	Low
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	0-3	Moderately 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.	Silt loam, Variable	0-15	Moderately well drained	No	C	Medium	Low	Medium	Low

[20] 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.

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[a]	Hydrologic Group	Runoff Potential	Permeability[b]	Erosion Potential	Compaction and Rutting Potential
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, Sand	0-5	Somewhat excessively drained to excessively drained	No, Yes	A	Low	High	Low	High, due to hydric soil and poor drainage conditions
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, Extremely cobbly clay, Extremely gravelly silt loam, Extremely gravelly silty clay loam, Gravelly silt loam, Gravelly silty clay, Gravelly silty clay loam, Loam, Silt loam, Silty clay, Silty clay loam, Very cobbly silty clay loam, Very fine sandy loam, Very gravelly clay loam, Very gravelly silt loam, Very gravelly silty clay loam	0-50	Moderately well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
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.	Sand, Unweathered bedrock, Very fine sandy loam	0-20	Moderately well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	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, Clay loam, Fine sandy loam, Flaggy silty clay loam, Gravelly loam, Loam, Silt loam, Silty clay, Silty clay loam, Very fine sandy loam, Very flaggy silt loam	0-50	Somewhat poorly drained to excessively 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).	Extremely gravelly clay loam, Extremely gravelly silt loam, Gravelly loam, Gravelly silt loam, Silt loam, Very gravelly loam, Very gravelly silt loam	1-45	Moderately well drained to somewhat excessively drained	No	B, C	Medium	Moderate, Low	Medium	Low

[a] 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” (NRCS, 2015c)
[b] Based on Runoff Potential, described in Section 10.1.2.5.
Sources: (NRCS, 2015a) (NRCS, 1999)

10.1.2.5. *Runoff Potential*

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[21] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 10.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Missouri.

Group A **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[22] 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 Missouri.

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. Aquents, Aquolls, Fluvents, Udalfs, Udepts, Udolls, and Udults fall into this category in Missouri.

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. Aqualfs, Aquepts, Aquolls, Arents, Orthents, Udalfs, Udepts, Udolls, and Udults fall into this category in Missouri.

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, Aquents, Aquepts, Aquerts, Aquolls, Udalfs, Udepts, and Udolls fall into this category in Missouri.

10.1.2.6. *Soil Erosion*

"Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity" (NRCS, 2015f). Water-induced erosion can transport soil

[21] 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.

[22] 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)

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 (NRCS, 1996a). Table 10.1.2-3 provides a summary of the erosion potential for each soil suborder in Missouri. Soils with medium to high erosion potential in Missouri include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Arents, Fluvents, Orthents, Udalfs, Udepts, Udolls, and Udults suborders, which are found throughout most of the state (Figure 10.1.2-2).

10.1.2.7. *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 (NRCS, 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 (USFWS, 2009). 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 10 tons can cause soil compaction of greater than 12 inches (NRCS, 1996b) (NRCS, 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 (NRCS, 1996b). Table 10.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Missouri. Soils with the highest potential for compaction and rutting in Missouri include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, and Psamments suborders, which are found primarily in northern and eastern areas of the state, and along the Missouri and Mississippi Rivers (Figure 10.1.2-2).

10.1.3. Geology

10.1.3.1. *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 10.1.4), Human Health and Safety (Section 10.1.15), and Climate Change (Section 10.1.14).

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

- Section 10.1.3.3, Major Physiographic Regions and Provinces[23,24]
- Section 10.1.3.4, Surface Geology
- Section 10.1.3.5, Bedrock Geology[25]
- Section 10.1.3.6, Paleontological Resources[26]
- Section 10.1.3.7, Fossil Fuel and Mineral Resources
- Section 10.1.3.8, Geologic Hazards[27]

10.1.3.2. *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 10.1.3-1.

Table 10.1.3-1: Relevant Missouri Geology Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Missouri Building Codes	Local Agencies	Provide seismic guidelines for building (Saint Louis County Missouri, 2015) (Jefferson County, Missouri, 2015) (Clay County, Missouri, 2015).

10.1.3.3. *Environmental Setting: Physiographic Regions and Provinces*

The concept of physiographic regions was created in 1916 by geologist Nevin Fenneman as a way to describe areas of the United States based on common landforms (i.e., not climate or vegetation). Physiographic regions are areas of distinctive topography, geography, and geology. Important physiographic differences between adjacent areas are generally 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 sub-divided into physiographic provinces based on differences observed on a more local scale (Fenneman, 1916).

Missouri has three major physiographic regions: Atlantic Plain (Coastal Plain Province), Interior Highlands (Ozark Plateaus Province), and Interior Plains (Central Lowland Province) (USGS, 2003b). The locations of these regions are shown in Figure 10.1.3-1 and their general characteristics summarized in the following subsections.

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

[24] Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

[25] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015d).

[26] Paleontology: "Study of life in past geologic time based on fossil plants and animals" (USGS, 2015e).

[27] 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).

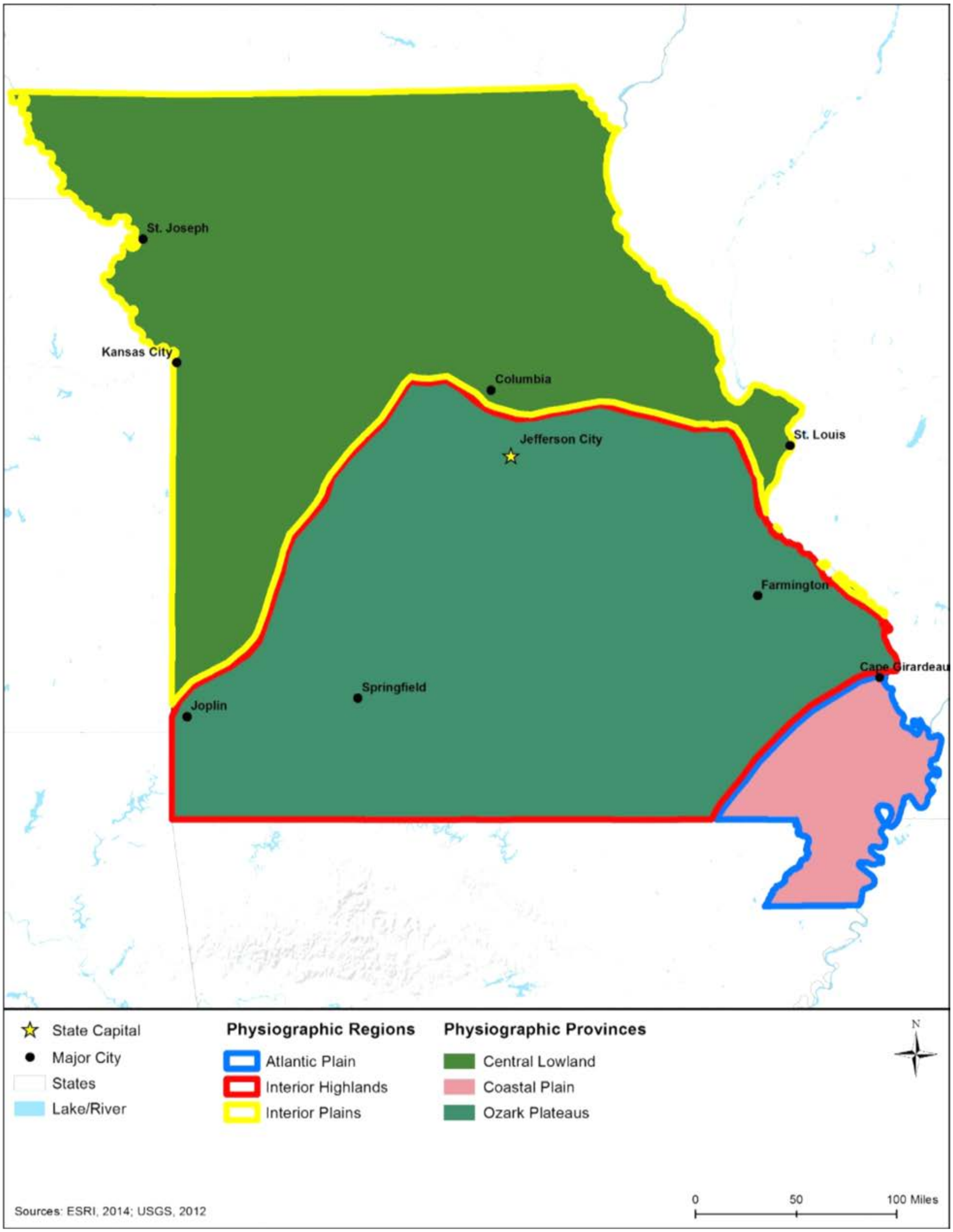

Figure 10.1.3-1: Physiographic Regions and Provinces of Missouri

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. Sedimentary[28] strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains, which began to form 480 to 440 million years ago (MYA), dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain.[29] The area is characterized by gentle topography and a transition zone between the land and sea often having marshes, lagoons, swamps, sand bars, and reefs. Deposits of coastal marine life over millions of years form the basis for rich fossil fuel reserves in the region (NPS, 2015a).

Coastal Plain Province – The Coastal Plain Province includes portions of extreme southeastern Missouri. Missouri's Coastal Plain is noted for its flat topography, which is attributable to repeated flooding by the Mississippi River (Gillman, 2013). In general, the Missouri Coastal Plain is about 500 feet above sea level (ASL) (USGS, 1997). “Contrasting sharply with the surrounding Mississippi River Delta, Crowley's Ridge is the [province's] most prominent geographic feature” (Gillman, 2013). Crowley's Ridge begins near Cape Girardeau and stretches about 200 miles to the southwest to Helena, Arkansas. This topographic feature rises about 250 feet above the surrounding landscape (MDC, 2015a).

Interior Highlands Region

The Interior Highlands Region includes the elevated portions of Illinois, Missouri, Arkansas and Oklahoma, and stands 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)

Ozark Plateaus Province – Within the Interior Highlands Region, the Ozark Plateaus Province covers about 40,000 square miles, including much of central and southern Missouri. The Ozark Plateaus Province is a “high, hilly landscape on stratified rocks that is bounded by topographic lowlands” (NPS, 2014a). Missouri's Ozark Plateaus Province is primarily underlain by limestone[30] and dolomite,[31] which contribute to the creation of karst[32] topography throughout the

[28] 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, 2014c)

[29] 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.

[30] 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, 2015f)

[31] Dolomite: "A magnesium-rich carbonate sedimentary rock. Also, a magnesium-rich carbonate mineral ($CaMgCO_3$)." (USGS, 2015f)

province. "This region also is home to the St. Francois Mountains, the eroded remnants of ancient volcanoes, providing a rare glimpse of igneous[33] rocks in the nation's mid-continent." Precambrian (older than 542 MYA) rocks are exposed within the St. Francois Mountains (USGS, 1997), which include Taum Sauk Mountain. At 1,772 feet ASL, Taum Sauk Mountain is the highest point in Missouri (Gillman, 2013).

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama) and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, 1916). Metamorphic and igneous rocks dating to the Precambrian Era (older than 542 million years ago [MYA]) underlie the entire region. There is minimal topographic relief throughout the region, except for the Black Hills of South Dakota. During the Mesozoic Era, much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary rocks which lie on top of the Precambrian basement rocks. Erosion from the Rocky Mountains to the west and the Ozark/Ouachita Mountains to the east, also contributed to the formation of sandstone,[34] mudstone,[35] and clay (USGS, 2014b).

As reported above, the Interior Plains Region within Missouri is composed of one physiographic province: the Central Lowland (USGS, 2003b).

<u>Central Lowland Province</u> – As the largest physiographic province in the United States, the Central Lowland Province includes more than 580,000 square miles and encompasses the eastern portion of the Interior Plains Region. Much of the region is flat lying (NPS, 2014a). The Central Lowland is comprised of a portion of western Missouri, as well as the northern half of the state. The topography of Missouri's Central Lowland Province is noted for its smooth, gently rolling landscapes that formed as a result of glacial advances and retreats. "Fine-grained sediments were deposited along the major river valleys. Many of the particles were later blown into ridges of dune-like hills that rise above the surrounding landscape" (Gillman, 2013).

10.1.3.4. *Surface Geology*

Surficial geology is characterized by materials such as till,[36] 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

[32] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater." (USGS, 2015f)

[33] Igneous Rocks: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)." (USGS, 2015f)

[34] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015f)

[35] Mudstone: "A very fine-grained sedimentary rock formed from mud." (USGS, 2015f)

[36] 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).

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[37], subsidence[38], and erosion (Thompson, 2015).

Most of northern Missouri is covered in surface deposits that are attributable to glaciation. Glacial deposits in northern Missouri emanated from either the Nebraskan or Kansan (2.5 to 0.5 MYA) glacial advances. In particular, till and erratic[39] deposits are evident throughout the Missouri River Valley. "An erratic northwest of Milan in Sullivan County [measures] 20 feet wide by 24 feet long. Its estimated weight is about 384 tons." River bluffs along the Missouri River Valley are composed of outwash[40] silt and sand deposits from the Illinoian (191,000 to 130,000 years ago) and Wisconsinan (85,000 to 11,000 years ago) glaciations. As glacial melting stopped each winter, the floodplain dried up, and sediments were redeposited as loess.[41] "Though loess deposits exist along the entire length of the Missouri River in [Missouri], they are especially deep and prominent in Atchison and Holt Counties north of St. Joseph." In some locations, these deposits measure more than 200 feet deep. (MDC, 2001)

Figure 10.1.3-2 depicts a generalized illustration of the surface geology for Missouri.

[37] Slope failure: "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)

[38] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).

[39] Erratic: "A rock of unspecified shape and size, transported a significant distance from its origin by a glacier or iceberg and deposited by melting of the ice." (USGS, 2013b)

[40] Outwash: "Glacial outwash is the deposit of sand, silt, and gravel formed below a glacier by meltwater streams and rivers." (USGS, 2015f)

[41] Loess: "A wind-blown deposit of sediment made mostly of silt-sized grains." (USGS, 2015f)

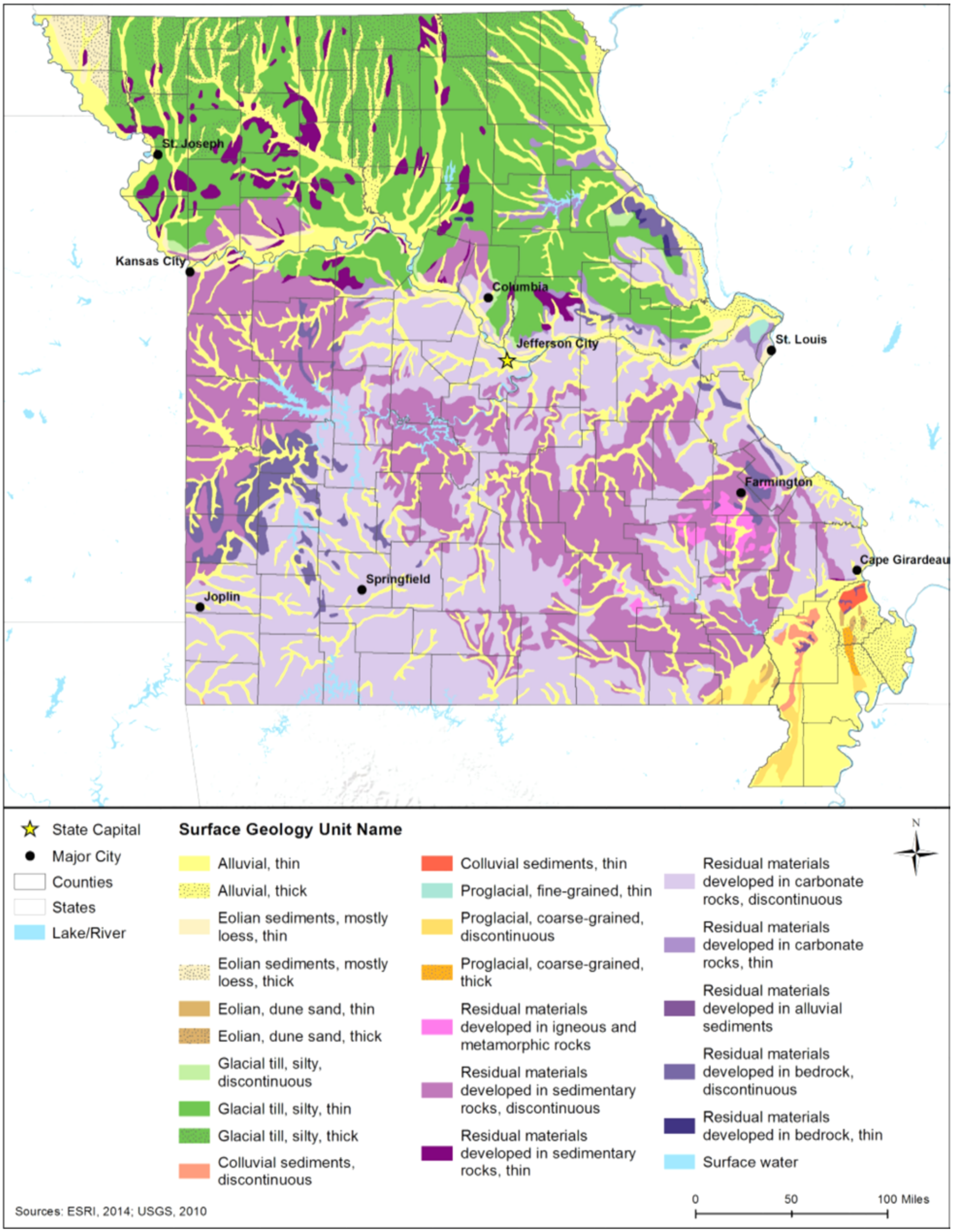

Figure 10.1.3-2: Generalized Surface Geology for Missouri

10.1.3.5. *Bedrock Geology*

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015a) reveals important information about a region's surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),[42] rock composition, and regional tectonism.[43] 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).

Missouri's bedrock geology varies significantly by physiographic province. Within the Coastal Plain Province in the southeastern portion of the state, “Tertiary [(66 to 2.6 MYA)] beds consist of unconsolidated to semiconsolidated clay and sand overlain by unconsolidated Quaternary [(2.6 MYA to present)] sand and gravel.” The Ozark Plateaus Province, in central and southern Missouri, contains rock outcroppings from the Precambrian (older than 542 MYA) and early Paleozoic (542 to 251 MYA) Eras. While most of the province is underlain by Ordovician (488 to 444 MYA) “dolomite and limestone interbedded with minor sandstone[44] and shale,[45] the oldest rocks in the state are Precambrian igneous and metamorphic[46] rocks that are exposed at the St. Francois Mountains. These rocks are locally surrounded by Cambrian (542 to 488 MYA) dolomite, sandstone, and shale, which are also limited to the geography surrounding the St. Francois Mountains. Within the Central Lowland Province, which includes northern and portions of western Missouri, Pennsylvanian (318 to 299 MYA) shale, limestone, sandstone, clay, and coal units are most dominant. (USGS, 1997) (MDNR, 2014c)

Figure 10.1.3-3 displays the generalized bedrock geology for Missouri.

[42] 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)

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

[44] Sandstone: “Sedimentary rock made mostly of sand-sized grains.” (USGS, 2015f)

[45] 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, 2015f)

[46] Metamorphic Rock: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids." (USGS, 2015f)

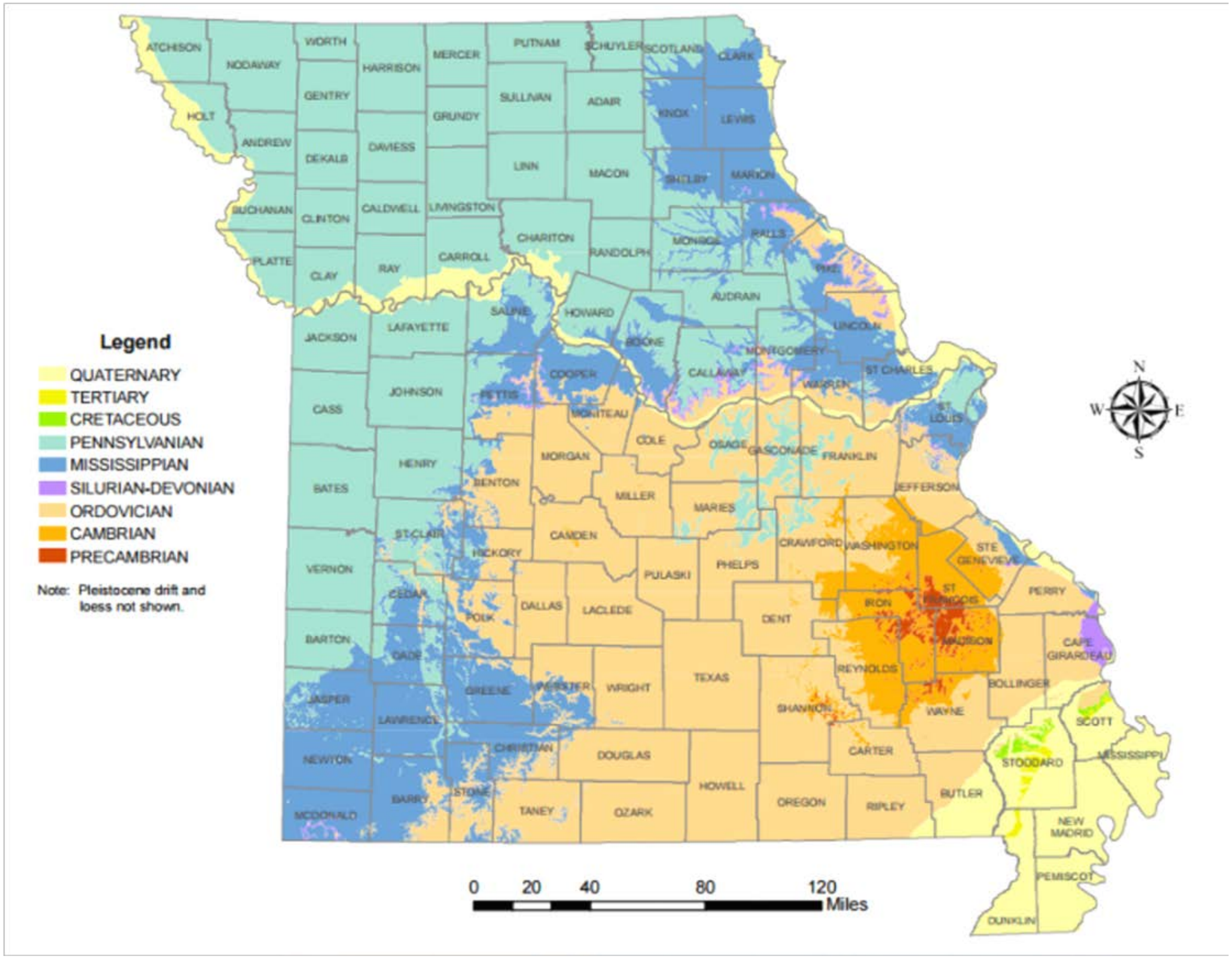

Figure 10.1.3-3: Generalized Bedrock Geology for Missouri

Source: (MDNR, 2009b)

10.1.3.6. *Paleontological Resources*

During much of the Cambrian (542 to 488 MYA) and Ordovician (488 to 444 MYA) Periods, Missouri was covered by shallow, warm seas, which yielded fossils of trilobites[47], brachiopods[48], monoplacophorans, snail-like organisms, stromatolites, bryozoans[49], gastropods[50], corals, cephalopods[51], echinoderms[52], and conodonts[53]. Warm, shallow seas persisted into the Silurian Period (444 to 416 MYA) resulting in the preservation of fossils from crinoids[54], starfish, brachiopods, and trilobites. Devonian (416 to 359 MYA) Period fossil include fish spines and teeth of placoderms. Fossils from the Carboniferous Period (359 to 299 MYA) include the remains of crinoids, sea urchins, and corals, as well as Missouri's state fossil, *Delocrinus missouriensis* (a crinoid). Sea level fluctuated during the late Carboniferous, resulting in periodic sediment deposition. Late Carboniferous sediments contain both terrestrial (e.g., ferns, scale trees, early conifers, and amphibian bones and trackways) and marine (e.g., cephalopods, clams, and gastropods) fossils. Few fossils are preserved from the Mesozoic Era (251 to 66 MYA). Mollusk fossils are recorded in Cretaceous (151 to 66 MYA) sediments along the Mississippi embayment. Magnolia and oak leaves are recorded in clays of the Tertiary (66 to 2.6 MYA) Period, while Ice Age mammal fossils are preserved from the Quaternary Period (2.6 MYA to present) (The Paleontology Portal,

Missouri State Fossil
Delocrinus missouriensis

Source: (Missouri Office of the Secretary of State, 2015)

[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] 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)
[49] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies." (Smithsonian Institution, 2016)
[50] 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)
[51] Cephalopod: "Any mollusk of the class Cephalopoda, which includes squids, octopus, and ammonites. They are characterized by the tentacles attached to their heads." (Smithsonian Institution, 2016)
[52] Echinoderm: "Common name for members of the phylum Echinodermata. These organisms are characterized by bodies showing radial symmetry (usually in fives) and the presence of tube feet in most forms." (Smithsonian Institution, 2016)
[53] Conodonts: "Any member of a group of worm-like, vertebrate organisms common from the Ordovician to the Triassic. Conodont dental batteries are important tools for Paleozoic and early Mesozoic biostratigraphy." (Smithsonian Institution, 2016)
[54] 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)

2015). Fossils, such as crinoids, trilobites, brachiopods, and bryozoans, can be found in over 10 counties within the state (MDNR, 2008).

10.1.3.7. *Fossil Fuel and Mineral Resources*

Oil and Gas

In 2015, Missouri produced 136,000 barrels of crude oil (EIA, 2016a). Production areas in Missouri include the Forest City Basin (northwest Missouri), the Lincoln Fold (northeast Missouri), and the Mississippi embayment (southeast Missouri) (MDNR, 2007).

In 2014, Missouri produced 9M cubic feet of natural gas (EIA, 2016b). Portions of northwest, north-central, and west-central Missouri have the potential to produce coalbed methane (MDNR, 2007).

Minerals

As of 2015, Missouri's total nonfuel mineral production was valued at $2.56B, which ranked 11th nationwide (in terms of dollar value). This level of production accounted for 3 percent of the total production value in the country. In 2015, Missouri's leading nonfuel minerals were crushed stone, Portland cement, sand and gravel, lead, and lime (USGS, 2016a). In 2011 Missouri led the country in fire clay and lime production. Other minerals produced in the state include cobalt, common clay and shale, copper, dimension stone[55], gemstones, perlite, silver, zinc, aluminum, fuller's earth, industrial sand, and construction sand and gravel (USGS, 2015b).

Missouri has been producing coal since the mid-19th century, but coal production has diminished since that time. In 2013, Missouri produced 414,000 short tons of coal, which ranked last among coal-producing states in the country. Coal is currently produced in the northwestern portion of the state (EIA, 2015c).

10.1.3.8. *Geologic Hazards*

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

Earthquakes

Areas of greatest seismicity in Missouri are concentrated in the southeast portions of the state. In 2012, 137 earthquakes of magnitude 1.0 on the Richter[56] scale or greater occurred within Missouri (MDNR, 2015i). 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

[55] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape." (USGS, 2016b).
[56] 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)

waves. The vibrations travel through the Earth and, if they are strong enough, they can damage structures and natural elements (e.g., rock bridges, trees, rivers) on the surface. Earthquakes can produce secondary flooding impacts typically resulting from dam failure (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 in Missouri, 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 earthquakes occur where Earth's tectonic plates collide. "When these plates collide, one plate slides (subducts) beneath the other, where it is reabsorbed into the mantle of the earth" (Oregon Department of Geology, 2015). Missouri is located far from any convergence boundaries that would result in subduction zone earthquakes.

Figure 10.1.3-4 depicts the seismic risk throughout Missouri; 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 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010a)

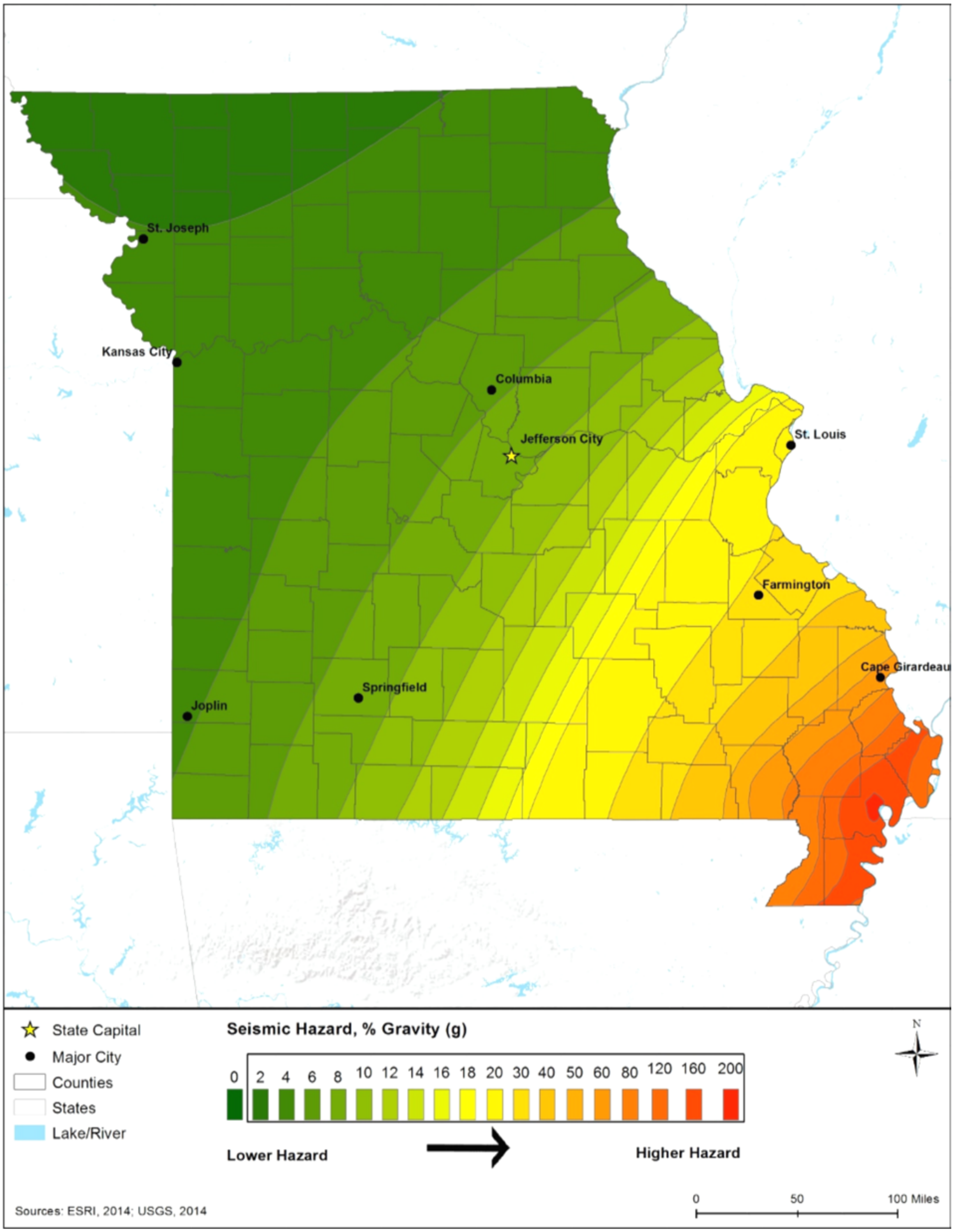

Figure 10.1.3-4: Missouri 2014 Seismic Hazard Map

Missouri is at risk of damaging earthquakes (greater than magnitude 6.3 on the Richter scale) due to its proximity to the New Madrid Seismic Zone (NMSZ). "The [NMSZ] is the most active earthquake region in the United States east of the Rocky Mountains. It covers parts of Arkansas, Illinois, Kentucky, Missouri and Tennessee" (MDNR, 2014d). In 2012, 223 earthquakes occurred along the entire length of the NMSZ, though most of these were not perceptible to humans (MDNR, 2015i). Three damaging earthquakes occurred along the NMSZ during 1811 and 1812. It is estimated that these earthquakes measured between 7.3 and 7.5 on the Richter scale (USGS, 2014f). "Geologic studies indicate that large earthquakes [also] occurred along the [NMSZ] in approximately 300 AD, 900 AD, and 1400 AD (MDNR, 2015i). Some estimates report that in any given 50 year time interval, there is a 10 percent chance of a magnitude 7 to 8 earthquake in the [NMSZ] (MDNR, 2015i).

Landslides

"[Landslides] are potential geologic hazards throughout Missouri and can occur where there are bluffs or steep slopes" (MDNR, 2015j). "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, 2003a). Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep,[57] slump,[58] mudflow, earth flow, and debris flow[59] regardless of the time scale (USGS, 2003a).

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, 2003a).

Areas within Missouri that are susceptible to landslides include portions of the state north of the Missouri River. "Particularly susceptible to slumps and earth flows are: loess along major river valleys and their tributaries, clayey till on slopes underlain by shale, [and some Pennsylvanian shale units in northwestern Missouri]." While landslides are infrequent in the Ozark Plateaus Province in southeastern Missouri, a few events have been observed along the Mississippi River in areas that are underlain by interbedded shale and limestone (Radbruch-Hall, et al., 1982).

[57] Creep: "slow, more or less continuous movement occurring on faults due to ongoing tectonic deformation. Faults that are creeping do not tend to have large earthquakes." (USGS, 2012d)

[58] Slump: "a type of landslide in which a mass of rock breaks away along a curved surface and rotates more or less intact downslope." (USGS, 2012d)

[59] Debris flow: "A type of landslide made up of a mixture of water-saturated rock debris and soil with a consistency similar to wet cement. Debris flows move rapidly downslope under the influence of gravity. Sometimes referred to as earth flows or mud flows." (USGS, 2012d) (USGS, 2012d)

Liquefaction[60] landslide hazards related to earthquakes are of particular concern to areas near St. Louis, especially in areas with unconsolidated surface deposits. Much of St. Louis is underlain by floodplain deposits from the Mississippi River, as well as glacial outwash deposits. "These unconsolidated granular materials are potentially susceptible to liquefaction during large earthquakes from nearby potentially undetected seismic sources, or possibly even more distant, larger seismic sources, such as the [NMSZ]… The St. Louis region experienced strong shaking from the 1811-1812 NMSZ events, and historical reports indicate that this shaking was sufficient to induce structural damage to buildings on the alluvium of the low-lying floodplain." (USGS, 2005)

Figure 10.1.3-5 displays the areas throughout Missouri that are at risk of landslide events.

Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). Land subsidence is common throughout areas of Missouri that are underlain karst[61] topography (MDNR, 2015k). The primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the United States is a consequence of 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 an aquifer is confined by layers of silt or clay, which do not transport groundwater, 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. Additionally, land subsidence can affect vegetation and land use. (USGS, 2013a)

[60] 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)

[61] Karst Topography: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater." (USGS, 2015f)

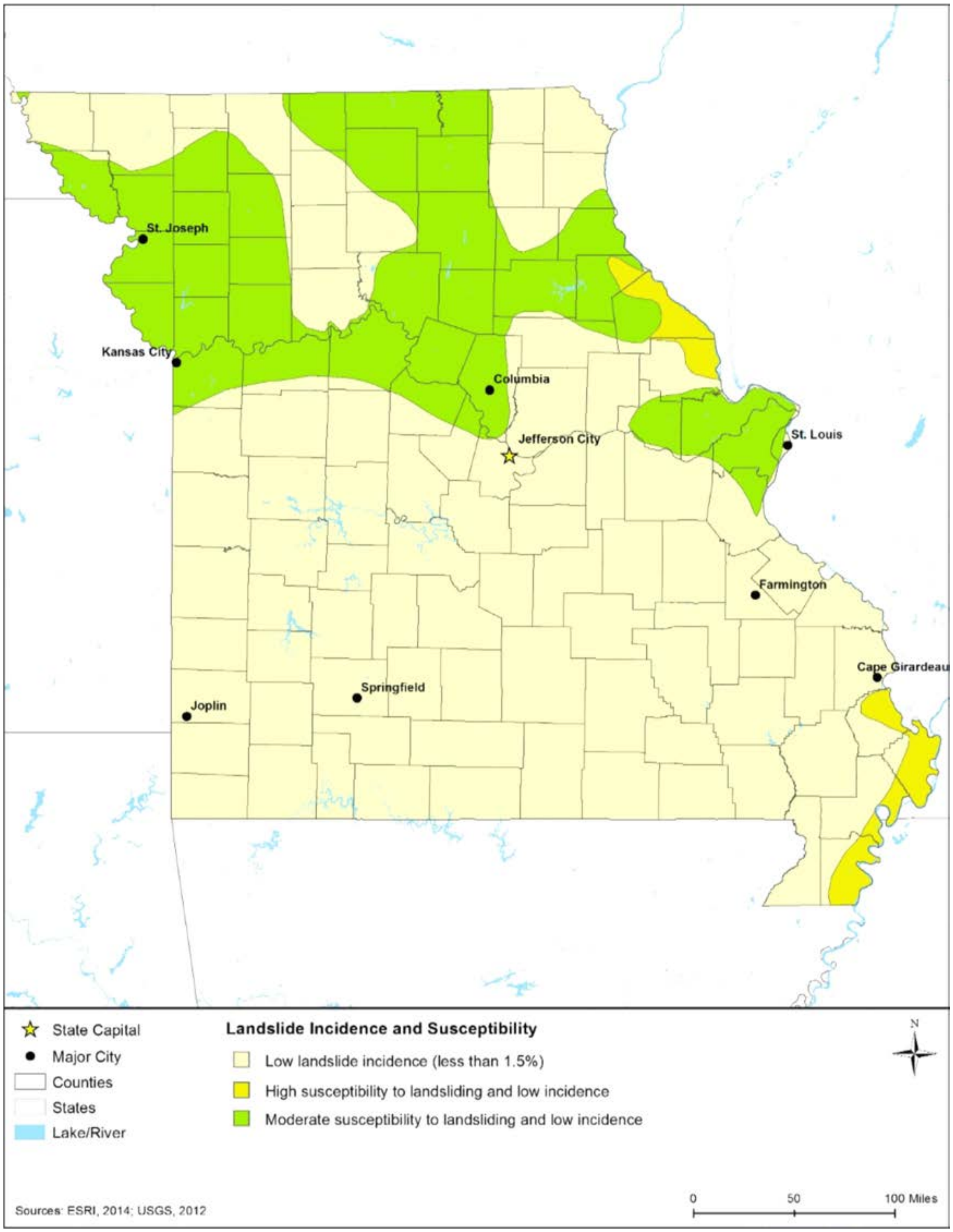

Figure 10.1.3-5: Missouri Landslide Incidence and Susceptibility Hazard Map[62]

[62] Susceptibility hazards not indicated in Figure 10.1.3-5 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

In Missouri, a significant cause of land subsidence is sinkholes that result from karst topography. "Much of the state is underlain by carbonate bedrock that has the potential for karst development. Water moving through tiny cracks in limestone and dolomite slowly dissolves the rock and carries it away in solution." Most of Missouri's sinkholes have been encountered in the southern half of the state, and along the Mississippi River. Nearly 16,000 sinkholes, some of which are more than 100 feet deep, have been documented in the state. "The largest known sinkhole in Missouri encompasses about 700 acres in western Boone County southeast of where Interstate 70 crosses the Missouri River." (MDNR, 2015k)

Figure 10.1.3-6 displays the areas throughout the state that are susceptible to land subsidence due to karst topography.

the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014e)

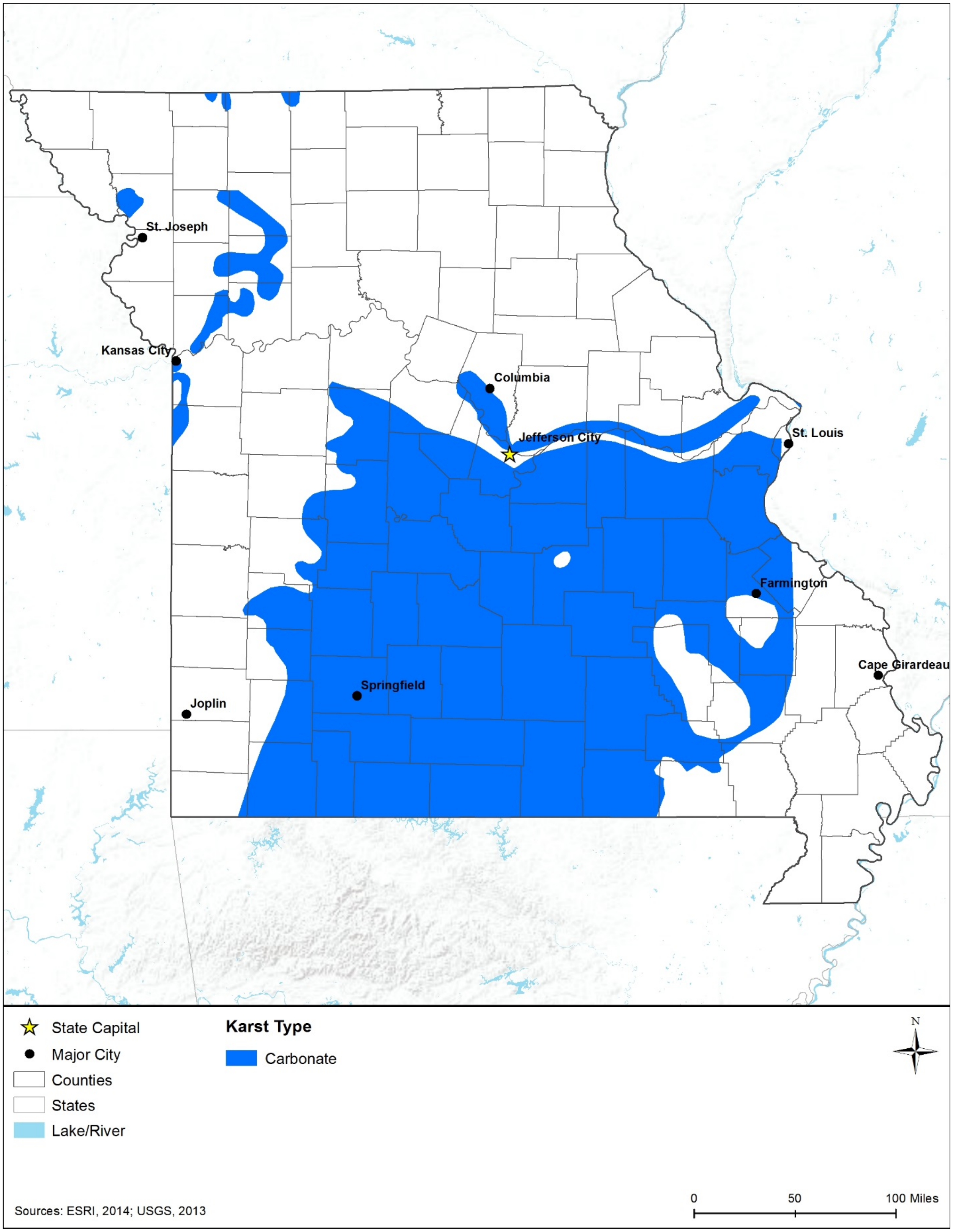

Figure 10.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Missouri

10.1.4. Water Resources

10.1.4.1. *Definition of the Resource*

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 10.1.5). 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 health, economic wellbeing, and ecological health. (USGS, 2014g)

10.1.4.2. *Specific Regulatory Considerations*

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations. Table 10.1.4-1 identifies the relevant laws and regulations for water resources in Missouri.

Table 10.1.4-1: Relevant Missouri Water Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
Missouri Pollutant Discharge Elimination System Program	Missouri Department of Natural Resources (MDNR)	Construction activities that disturb one or more acre of surface soil (MDNR, 2012).
CWA Section 404 permit, Nationwide Permit (NWP) Missouri regional conditions	U.S. Army Corps of Engineers (USACE), St. Louis District	Preconstruction notification (PCN) must be submitted to the USACE for activities in parts of the following waterbodies which are habitat for sensitive species: Belle Fountain/State Line Ditch, Big Piney, Big, Black, Bourbeuse, Castor, Current, Eleven Point, Gasconade, Jack's Fork, Little Black, Meramec, Mississippi, North Fork White, Osage, Sac, Salt, South Prong Little Black, and St. Francis Rivers, Bryant and Cane Creeks, Main Ditch, and the Osage Fork of the Gasconade (USACE - St. Louis District, 2015).
		PCN must be submitted to the USACE and Ameren Missouri for activities in the Lake of the Ozarks (USACE, 2015b).
		This NWP cannot be used to authorize activities in the Lake of the Ozarks (USACE, 2015b).
Clean Water Act (CWA) Section 401 permit	MDNR	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 MDNR indicating that the proposed activity will not violate water quality standards (MDNR, 2015m).
A Summary of Missouri Water Laws	MDNR	This Summary "provides an overview of the laws that affect the protection and use of Missouri's water resources. It supplies reference information about existing doctrines, statutes and case law" (MDNR, 2000).

10.1.4.3. *Environmental Setting: Surface Water*

Surface water resources are lakes, ponds, rivers, and streams. According to the MDNR, Missouri has approximately 258,886 miles of streams and about 908,993 acres of lakes. These surface waters supply drinking water; provide aquatic habitat; and support recreation, agriculture, fishing, and manufacturing across the state. (MDNR, 2014e).

Watersheds

Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains streams and rainfall to a common outlet (e.g., reservoir, bay). Missouri's waters (lakes, rivers, and streams) are divided into 11 major watersheds, or drainage basins (Figure 10.1.4-1) (MSWCD, 2015). Visit http://mdc.mo.gov/your-property/greener-communities/missouri-watershed-inventory-and-assessment for information and additional maps about each Missouri Department of Conservation (MDC) watershed's location, size, and water quality (MDC, 2015b).

The Lower Missouri-Grand-Chariton River Basin encompasses the entire northeastern and northcentral Missouri. East of this river basin is the Upper Missouri-Salt River Basin, which covers the northeastern corner of Missouri and extends southeast toward St. Louis. Within this watershed, the Salt River drains an approximate area of 2,914 square miles (MDC, 2015c). Lower Missouri-Blackwater-Lamine River Basin and the East Lower Missouri River Basin cover an area that covers a portion of central Missouri, extending from the state's western border to the Mississippi River on the eastern border. The Osage River Basin covers a large portion of central and southwest Missouri, and includes the state's two largest reservoirs, the Harry S. Truman Reservoir and Lake of the Ozarks. East of the Osage River Basin are the Gasconade River Basin and the Meramec River Basin, which drain a total area of approximately 4,955 square miles (MDC, 2015d) (MDC, 2015e). Spring-Elk River covers the far southwestern corner of Missouri, and is bordered to the east by the White River Basin. The White River Basin drains the entire southcentral portion of Missouri. The Upper Mississippi River Basin (below St. Louis) lies along the state's eastern border, extending south to the Lower Mississippi-Black River Basin. The Lower Mississippi-Black River Basin drains the far southeastern corner of Missouri.

Freshwater

As shown in Figure 10.1.4-1, there are nine major rivers in Missouri: Missouri, Mississippi, James, Big Piney, Current, St. Francis, Salt, Grand, and Platte. The eastern boundary of Missouri is formed by the Mississippi River, which stretches approximately 485 miles along the state's border. The Mississippi Rivers merges with the Missouri River near St. Louis, Missouri to form one of the largest river systems in the world. (Vandike, 1995) The St. Francis River originates in southeast Missouri and flows south to the Missouri-Arkansas border. This river drains an area of approximately 1,839 square miles in Missouri (MDC, 2015f). In northwestern Missouri, the Platte River flows south from Iowa to meet the Missouri River on the western border of Missouri. East of the Platte River is the Grand River, which also flows south from Iowa and drains more than 5,925 square miles within Missouri (MDC, 2015g).

Major lakes and reservoirs in Missouri include: Table Rock Lake, Lake of the Ozarks, Harry S. Truman Reservoir, Mark Twain Lake, and Thomas Hill Reservoir. Table Rock Lake is located in southwestern Missouri, approximately eight miles southwest of Branson, Missouri within the White River Basin. The reservoir covers an approximate area of 43,100 acres in Missouri and Arkansas, and receives inflow from the James River (USACE, 2015a). Lake of the Ozarks and Harry S. Truman Reservoir are large reservoirs located in central Missouri, and were built to control flooding within the state (MDC, 2015h) Mark Twain Lake, located in northeast Missouri, was formed when the Clarence Cannon Dam was constructed across the Salt River. The lake provides flood control, power generation, and recreational opportunities (MDNR, 2015t). West of Mark Twain Lake is Thomas Hill Reservoir, a 4,950 acre reservoir that provides habitat for wildlife, and offers many recreational opportunities (MDC, 2015i).

10.1.4.4. *Sensitive or Protected Waterbodies*

Wild and Scenic Rivers

A segment of the Eleven Point River (Figure 10.1.4-1) is a federally designated National Wild and Scenic River in Missouri (see Appendix C, Environmental Laws and Regulations, for more information about the Wild and Scenic Rivers Act). The designated segment includes approximately 44.4 miles of scenic river in southeast Missouri, and is characterized by “steep bluffs” with “sloping forested valleys and low-lying” freshwater ecosystems. The river includes areas of rapids and deep clear pools, and offers recreational opportunities, such as canoeing and fishing. (National Wild and Scenic Rivers System, 2015)

Special Resource Waters

Special Resource Waters within Missouri include Outstanding National Resource Waters. These waters “have outstanding national, recreational, and ecological significance” and “receive special protection against any degradation in quality.” Missouri rivers included in this designation include: the Current, Jacks Fork, and Eleven Point Rivers. In addition, Missouri has designated waterbodies as Outstanding State Resource Waters. This designation includes “high quality waters with a significant aesthetic, recreational, or scientific value” selected by the Missouri Clean Water Commission (MDNR, 2015u). Visit www.swl.usace.army.mil/Missions/Regulatory/MissouriSpecialResourceWaters.aspx for a complete list of these designated waters.

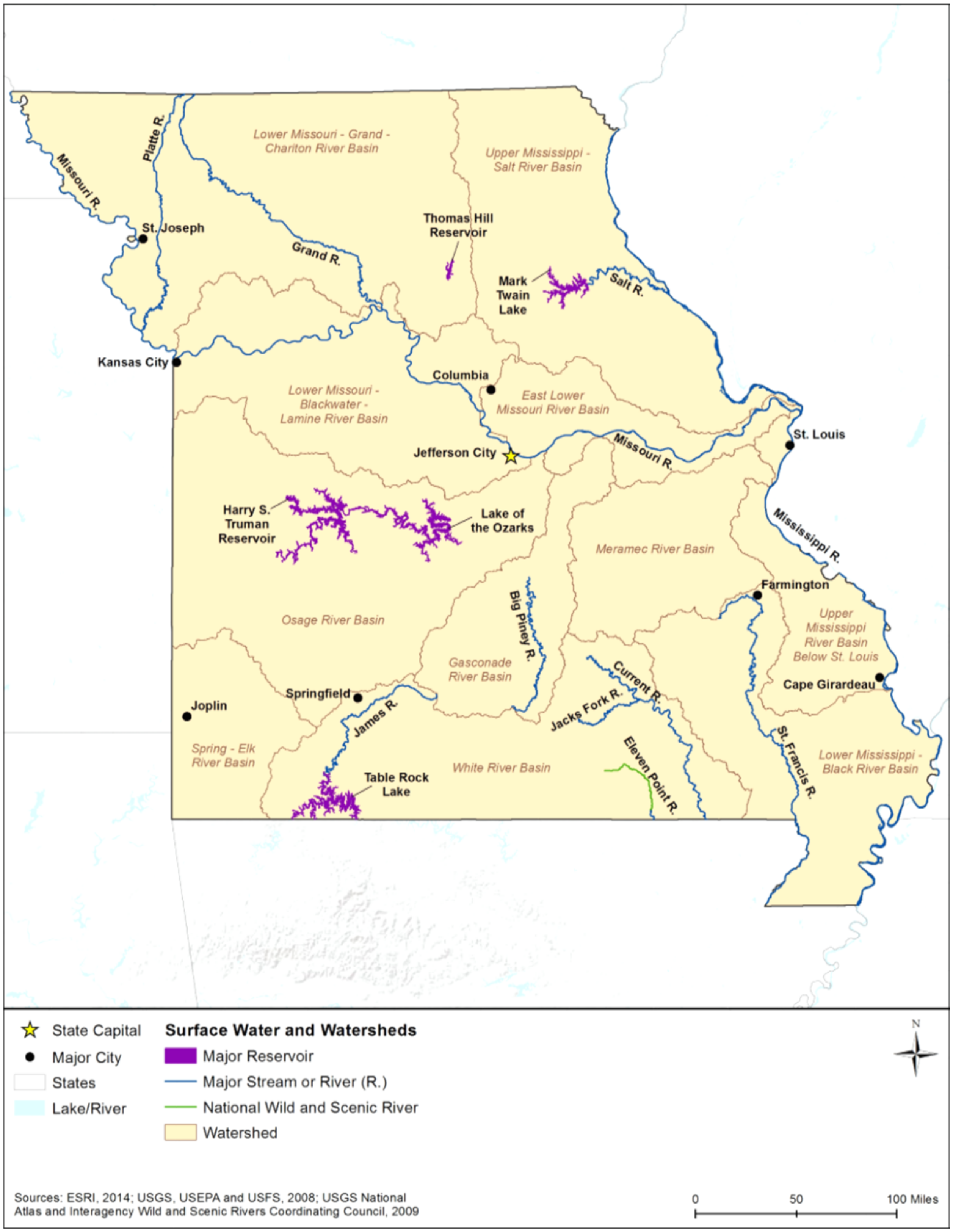

Figure 10.1.4-1: Major Missouri Watersheds and Surface Waterbodies

10.1.4.5. *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,[63] the causes of impairment, and probable sources. Table 10.1.4-2 summarizes the water quality of Missouri's assessed major waterbodies by category, percent impaired, designated use,[64] cause, and probable sources. Figure 10.1.4-2 shows the Section 303(d) waters in Missouri as of 2014.

As shown in Table 10.1.4-2, various sources affect Missouri's waterbodies, causing impairments. For example, Table Rock Lake is impaired by excess nitrogen, and Mark Twain Lake is impaired by mercury in fish tissue. Impaired Designated Uses of rivers include aquatic life, cold water fishery, secondary and whole body contact recreation, and general use. (USEPA, 2015a)

Table 10.1.4-2: Section 303(d) Impaired Waters of Missouri, 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	20.3%	54.2%	aquatic life, cold water fishery, secondary and whole body contact recreation and general use	dissolved oxygen, mercury, lead, pathogens [c]	municipal point source discharges, hydromodification,[d] industrial, agricultural, and urban runoff/storm sewers
Lakes, Reservoirs, and Ponds	88.1%	27.2%	aquatic life, cold water fishery, drinking water, and general use	chlorophyll-A/algal growth, nutrients such as nitrogen, and mercury	municipal point source discharges, atmospheric deposition,[e] and hydromodification

[a] Some waters may be considered for more than one water type.
[b] Missouri has not assessed all waterbodies within the state.
[c] Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015b).
[d] Hydromodification includes "activities that disturb natural flow patterns of surface water and groundwater," (e.g., construction, dams and impoundments, channelization, dredging, and land reclamation activities) (USEPA, 1975).
[e] Atmospheric deposition: the process by which airborne pollutants settle onto to the earth's surface and pollutants travel from the air into the water through rain and snow ("wet deposition"), falling particles ("dry deposition"), and absorption of the gas form of the pollutants into the water (USEPA, 2015b).

Source: (USEPA, 2015a)

[63] 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, 2015b).

[64] 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, 2015b).

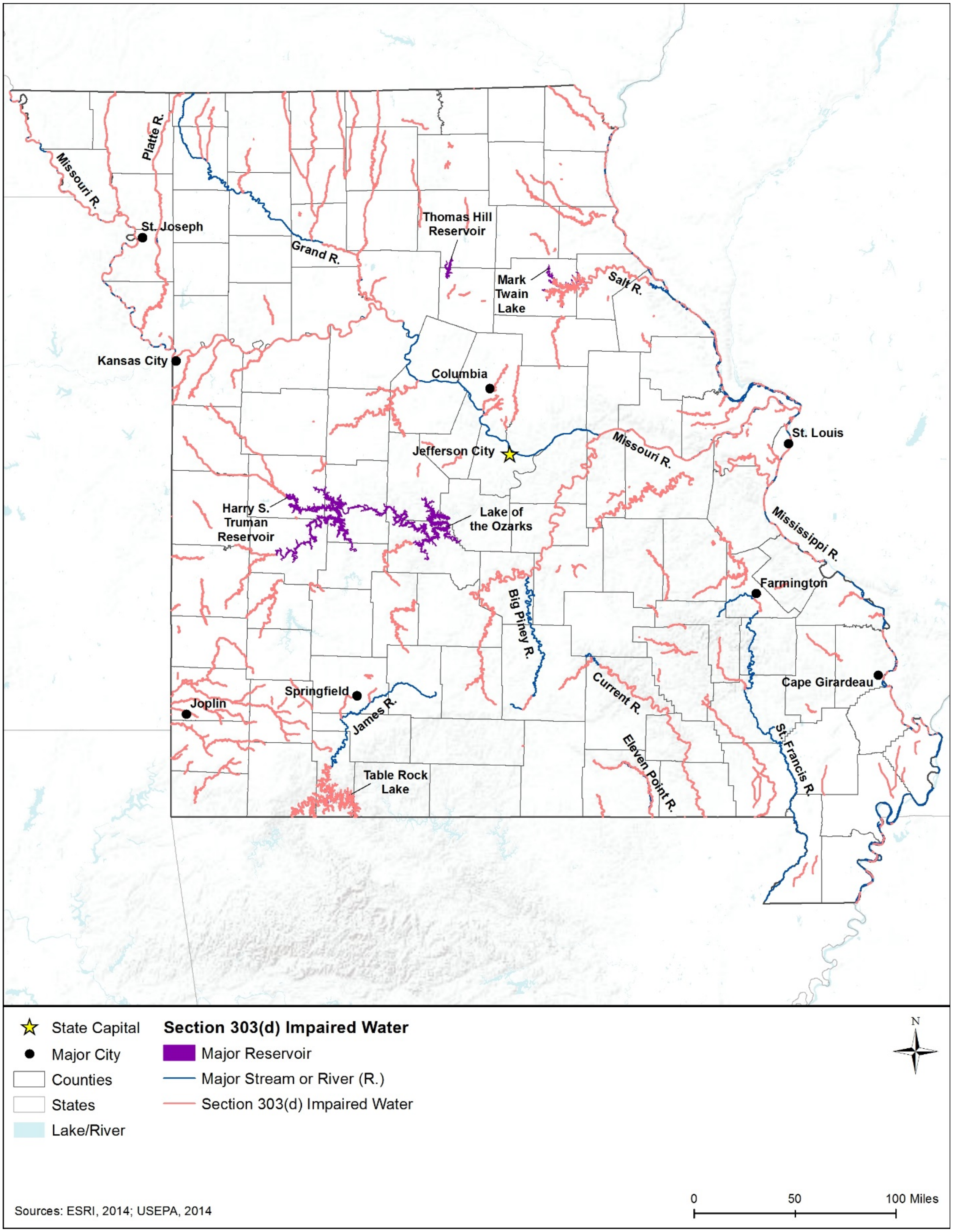

Figure 10.1.4-2: Section 303(d) Impaired Waters of Missouri, 2014

According to Missouri's 2014 Integrated Water Quality Report, about 46 percent of stream miles assessed in the state fully support designated uses, and 54 percent of stream miles are impaired for at least one designated use. Seventy-two percent of lake acres assessed met all designated uses. (MDNR, 2014e)

10.1.4.6. *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) (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 or lake flooding is the primary type of floodplain in Missouri, occurring along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In steep river valleys found in hilly areas, 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 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 Missouri, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, rapid snowmelt, debris and ice jams, over-development/impervious[65] surfaces, and dam failure (MEMA, 2013).

[65] Impervious: a hardened surface or area that does not allow water to pass through. For example, roads, rooftops, driveways, sidewalks, pools, patios, and parking lots are all impervious surfaces. (USEPA, 2015b)

Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. Based on historical flooding in Missouri, there have been more than 35 flood disaster declarations since 1976. Flood problems are most severe in the areas around major rivers, such as the Missouri and Mississippi Rivers (Figure 10.1.4-1). (MEMA, 2013)

Missouri Flooding 1993-1995

Missouri's worst repetitive flood events occurred from 1993-1995. Five presidential disaster declarations were made during this time frame, with four occurring within a 12-month period. Flooding began in May 1993 and resulted in 112 of the 114 Missouri counties to receive one or more disaster declarations. Typical width of the Missouri River is no more than a half mile wide. During the 1993 flooding, the river reached 20 miles wide near its confluence with the Mississippi River. In addition, mass federal and non-federal levee failure greatly contributed to the flooding. (MEMA, 2013)

Source: (USGS, 1993)

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 662 communities in Missouri 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 for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Missouri had 10 communities participating in the CRS (FEMA, 2014d).[66]

10.1.4.7. *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)

[66] A list of the 10 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014e) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

or unconfined (no layer to restrict the vertical movement of groundwater) aquifers (USGS, 1999). 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 hydrologic (water) cycle.[67]

Missouri's principal aquifers consist of sandstone,[68] sand and gravel aquifers of alluvial and glacial origin,[69] limestone,[70] shale, and unconsolidated sedimentary deposits[71]. Approximately 1.8 million residents draw drinking water from Missouri's groundwater resources (MDNR, 2015v). Generally, the water quality of Missouri's aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include leaking septic tanks, leaking underground storage tanks, domestic wastewater, and animal feeding operations (MDNR, 2014e).

Table 10.21.4-3 provides details on aquifer characteristics in the state; Figure 10.1.4-3 shows Missouri's principal aquifers. There are no sole source aquifers in the state.

[67] The hydrologic or water cycle is the "motion of water from the ground to the atmosphere and back again" through evaporation, transpiration, condensation, precipitation, and runoff. (National Weather Service, 2016)

[68] 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)

[69] Sand and gravel aquifers of alluvial (sand, silt, or gravel materials left by river waters) and glacial origin are highly productive aquifers in the northern part of the country, consisting of mostly sand and gravel deposits formed by melting glaciers. (USGS, 2015g)

[70] Limestone is "A mineral composed of iron oxides and water. Rust. Very common in many rocks after weathering at the Earth's surface. Imparts brown or yellow colors to many rocks." (USGS, 2015f)

[71] Unconsolidated sedimentary deposits: "loosely bound sediments such as sand, gravel, and silt, which tend to accumulate in low areas or valleys." (USGS, 2015h)

Table 10.1.4-3: Description of Missouri's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Aquifers of Alluvial and Glacial Origin/Surficial aquifer system Unconsolidated sand and gravel	Throughout the northern half of Missouri	Typically, the water is very hard. Maximum concentrations of nitrate plus nitrite and fluoride did not exceed the primary drinking-water standards. Water from these aquifers is used primarily for public supplies, self-supplied rural-domestic use, and industry.
Cambrian-Ordovician aquifer system Primarily consists of shale	Small part of eastern Missouri, northwest of St. Louis	Permeability varies considerably. Water is fresh in a large area of east-central Missouri but is slightly to moderately saline in northern and northwestern Missouri. Western Interior Plains aquifer system is slightly saline or a brine. Mainly used for domestic and stock-watering supplies.
Mississippi River Valley alluvial aquifer[72]/Mississippi Embayment aquifer system Unconsolidated gravel, sand, silt, and clay	Mississippi Alluvial Plain of southeastern Missouri	Contains median dissolved-solids concentration with minimum detection of nitrate. Water is suitable for most uses though area intensively developed for agricultural purposes and the aquifer is the principal source of water for irrigation.
Mississippian aquifers Limestone of Mississippian age	Extends over all of Missouri north of the Missouri River, except for small areas near the Mississippi and the Missouri Rivers	Chemical quality of the water varies considerably. The aquifer contains freshwater only in the eastern one-third of its extent; elsewhere, it contains slightly saline to very saline water. Contains high concentrations of dissolved-solids.
Ozark Plateaus aquifer system Consolidated dolomite and limestone with minor layers of sandstone	Covers most of southern Missouri	Permeability varies considerably with median dissolved-solids concentration. Substantial quantities of water are used for public, irrigation, industrial, and domestic supplies are pumped from this aquifer.

Source: (Moody, Carr, Chase, & Paulson, 1986) (Miller, 1997)

[72] An alluvial aquifer is formed on a floodplain or in a river channel by material deposited during physical processes. (Kansas Geological Survey, 2000)

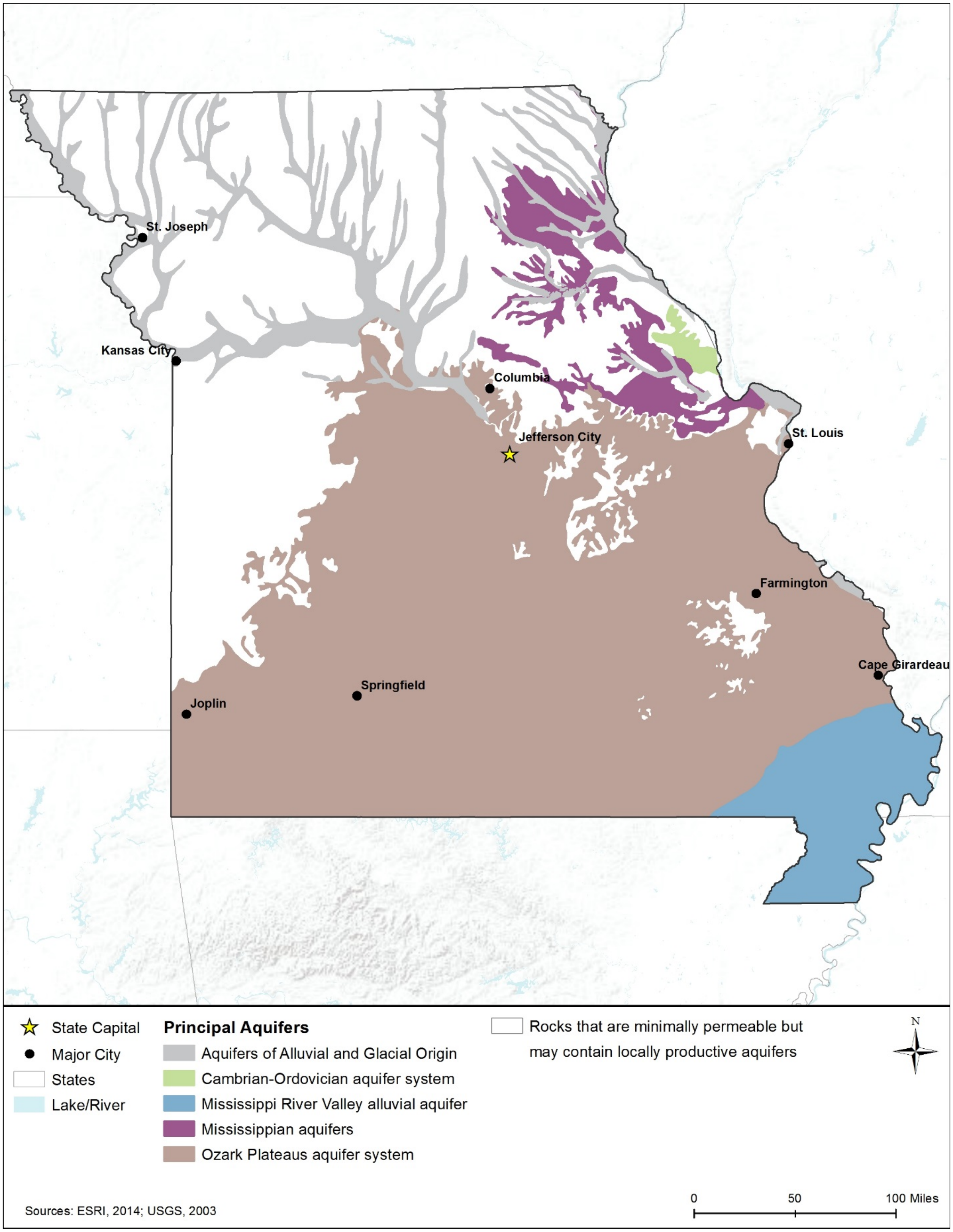

Figure 10.1.4-3: Principal Aquifers of Missouri

10.1.5. Wetlands

10.1.5.1. *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).

10.1.5.2. *Specific Regulatory Considerations*

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table summarizes the major Missouri state laws and permitting requirements relevant to the state's wetlands.

Table 10.1.5-1: Relevant Missouri Wetlands Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 404 permit, Nationwide Permit (NWP) Missouri regional conditions	USACE, St. Louis District	Preconstruction notification must be submitted to the USACE for any activities in fens,[a] seeps, or bogs of any size (USACE, 2015b)
		Preconstruction notification must be submitted to the USACE and Ameren Missouri for activities in the Lake of the Ozarks (USACE, 2015b).
CWA Section 401 permit	MDNR	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 MDNR indicating that the proposed activity will not violate water quality standards (MDNR, 2015m).
Missouri Pollutant Discharge Elimination System Program	MDNR	Construction activities that disturb one or more acre of surface soil (MDNR, 2012).

[a] Fens are "peat-forming wetlands that receive nutrients from sources other than precipitation: usually from upslope sources through drainage from surrounding mineral soils and from groundwater movement." Fens are less acidic than bogs with higher nutrient levels. (USEPA, 2015c)

10.1.5.3. *Environmental Setting: Wetland Types and Functions*

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al. (1979). The WCS includes five major wetlands systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Three of these systems—Riverine, Lacustrine, and Palustrine—are present in Missouri, as detailed in Table 10.1.5-2 (USFWS, 2015a) (FGDC, 2013).

- The Marine System consists of open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 percent salty) water chemistry; minimal influence from rivers or 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 et al., 1979) (FGDC, 2013).

Table 10.1.15-2 uses 2014 NWI data to characterize and map Missouri wetlands on a broad-scale.[73] The data are not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure 10.1.5-1 palustrine wetlands are found across the state. The map codes and colorings in Table 10.1.5-2 correspond to the wetland types in the figures.

[73] 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 10.1.5-2: Missouri 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.	Throughout the state, often on river and lake floodplains	753,593
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, prairie potholes, and sloughs.	Throughout the state	262,481
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	264,691
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,[74] and other miscellaneous wetlands are included in this group.	Throughout the state	2,884
Riverine wetland	R	Riverine systems include rivers, creeks, and streams. They are contained in natural or artificial channels periodically or continuously containing flowing water.	Throughout the state	23,483
Lacustrine wetland	L2	Lacustrine systems 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	11,976
			TOTAL	**1,319,108**

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

[74] Saline seep is an area where saline groundwater discharges at the soil surface. These wetland types are characterized by saline soils and salt tolerant plants (City of Lincoln, 2015)

Palustrine Wetlands

In Missouri, palustrine wetlands include the majority of vegetated freshwater wetlands. Freshwater wetlands in Missouri include marshes, swamps, bottomland forests, bottomland prairies, and groundwater seeps.[75] Marshes are found around oxbow lakes and sloughs, as well as relic river channels in southeast, central, north, and western Missouri. Shrub swamps are found in or around swamps, marshes, and bottomland forests, and are usually dominated by buttonbush (*Cephalanthus occidentalis*) and willows (*Salix sp.*). Swamps are only found in southeastern Missouri, in the Mississippi River ancient floodplain. They are dominated by trees such as bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*). Bottomland forests in Missouri are usually found in the lowlands along rivers, and are characterized by large trees and vines. Bottomland prairies found in northern and west-central Missouri, in floodplains above marshes. They are characterized by prairie cordgrass (*Spartina pectinata*), and are typically only flooded during the spring and summer (Leahy, 2001).

Based on the USFWS NWI 2014 analysis, PFO/PSS are the dominant wetland type (57 percent), followed by PEM (20 percent), PUB/PAB (20 percent), and other palustrine wetlands (less than 1 percent). There are currently about 1.3 million acres of wetlands in the state (USFWS, 2014a). In 2011, it was estimated nearly 90 percent of Missouri's original wetlands have been altered or destroyed. The main threats to wetlands in Missouri include alteration or destruction from land development and agricultural activities (MDNR, 2011).

10.1.5.4. *Environmental Setting: Wetlands of Special Concern or Value*

Fens, Seeps, and Bogs

In Missouri, areas classified as a fen, seep, or bog are protected under the USACE Nationwide permit. Groundwater seeps, also called acidic seeps or fens, are typically found in the Ozarks, along the base of hillsides, where groundwater percolates up to the surface. These seeps commonly accumulate peat and muck from the constantly saturated conditions. Fens are found where alkaline groundwater percolates up through limestone and dolomite, usually in springs, sinkholes, caves, and karst landscapes in the Ozarks. Dominant vegetation includes wildflowers, bulrushes (*Typha sp.*), and sedges (*Cyperaceae sp.*). Acidic seeps are found where groundwater flows through rocks such as sandstone, sands, and igneous rocks. These seeps typically contain ferns (*Asplenium*) and mosses (*Bryophyta sp.*), and are found in the Ozarks, and in southeast Missouri along Crowley's Ridge. (Leahy, 2001)

[75] See Section 10.1.5.4 for a description of groundwater seeps.

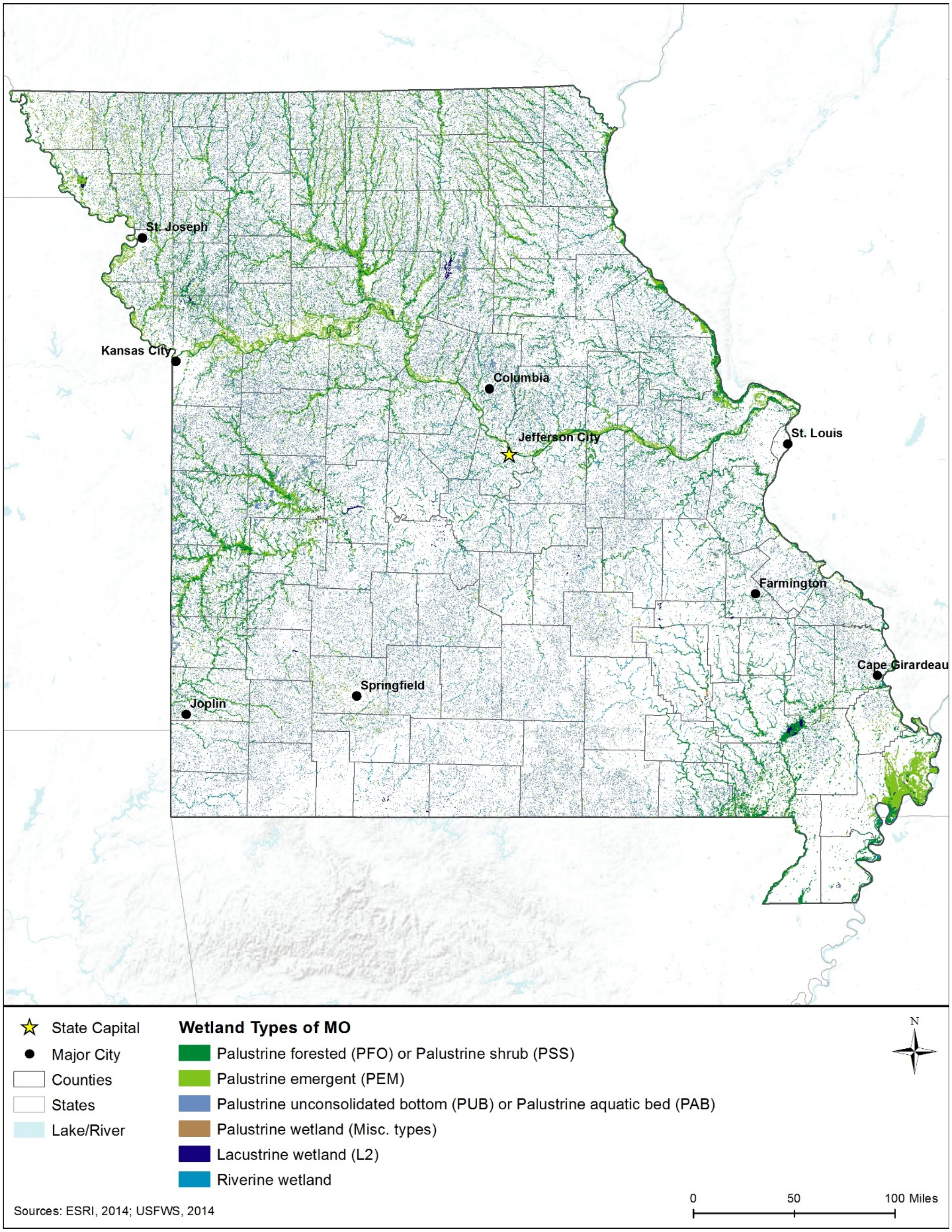

Figure 10.1.5-1: Wetlands by Type, in Missouri, 2014

Other Important Wetland Sites in Missouri

Natural Areas in Missouri represent some of the last original landscapes of the state, including rare wetlands (MDC, 2015j). To learn more about state Natural Areas, visit http://mdc.mo.gov/discover-nature/places-go/natural-areas.

National Natural Landmarks range in size from nearly 30 acres to over 1,300 acres, and are owned by Missouri DNR, Missouri Department of Conservation, U.S. Forest Service, The Nature Conservancy, and private businesses and individuals (NPS, 2015b). Section 10.1.8, Visual Resources, describes Missouri's National Natural Landmarks.

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, U.S. Forest Service, and U.S. National Park Service, and easements managed by natural resource conservation groups such as The Nature Conservancy, Ducks Unlimited, and Missouri Prairie Foundation. 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 202,823 acres in conservation easements in Missouri (NCED, 2015).

10.1.6. Biological Resources

10.1.6.1. *Introduction*

This section describes the biological resources of Missouri. Biological resources include terrestrial[76] vegetation, wildlife, fisheries and aquatic[77] habitats[78], and threatened[79] and endangered[80] species as well as 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, Missouri supports a wide diversity[81] of biological resources ranging from prairie communities in the northern and central portions of the state to upland savanna[82] and open woodland habitat in the Ozark region of southeastern Missouri. Each of these topics is discussed in more detail below.

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76 Terrestrial: "Pertaining to land." (USEPA, 2015m)

77 Aquatic: "Pertaining to water." (USEPA, 2015m)

78 Habitat: "The environment in which an organism or population of plants live; the normal kind of location inhabited by a plant or animal." (USEPA, 2015m)

79 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)).

80 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)).

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

82 Savannas "consist of widely spaced trees, mainly oaks with occasional hickories, growing over an open understory and a thick ground cover of prairie grasses and wildflowers." (MDC, 2000)

10.1.6.2. *Specific Regulatory Considerations*

The federal laws relevant to the protection and management of biological resources in Missouri are summarized in detail in Appendix C, Environmental Laws and Regulations. Table 10.1.6-1 summarizes major state laws relevant to Missouri's biological resources.

Table 10.1.6-1: Relevant Missouri Biological Resources Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
MRS 263.190 and 263.200, Missouri Noxious Weed Regulations	Missouri Department of Agriculture (MDA)	Deems it illegal for any person to collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species listed as prohibited.
MRS 263.130.1, Missouri Plant Pest Regulations	MDA	Gives the state entomologist authority to establish quarantines for plant pests deemed injurious to the state of Missouri.
MRS 10.4-11.7, Prohibited Species	Missouri Department of Conservation (MDC)	Stipulates that prohibited species may not be imported, exported, transported, sold, purchased, or possessed alive in the state of Missouri.

10.1.6.3. *Terrestrial Vegetation*

The distribution of flora within the state is a function of the characteristic geology,[83] soils, climate, and water of a given geographic area and correlates with distinct areas identified as ecoregions.[84] Ecoregions are broadly defined areas that share similar characteristics, such as climate,[85] 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) (USFS, 2015a) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with geographic regions of a state. In Missouri, the three main geographic regions include the Ozarks, Coastal Plain, and Interior Plains. 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. This Section provides an overview of the terrestrial vegetation resources for Missouri at USEPA Level III. (USEPA, 2016a)

As shown in Figure 10.1.6-1, the USEPA divides Missouri into six Level III ecoregions. The six ecoregions support a variety of different plant communities, all predicated on their general

[83] "Geology is the study of the planet earth- the materials it is made of, the processes that act on those materials, the products formed, and the history of the planet and its life forms since its origin." (USEPA, 2015m)

[84] Ecoregion: "A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables." (USEPA, 2015m)

[85] Climate: "Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO)." (USEPA, 2015m)

location within the state. Communities range from upland deciduous broadleaf forests and savannas in the Ozarks region in southern Missouri, to prairie communities in the north and flooded bottomland forests and cypress swamps in the Coastal Plains region in the southeastern portion of the state. Table 10.1.6-2 provides a summary of the general abiotic[86] characteristics, vegetative communities, and the typical vegetation found within each of the six Missouri ecoregions.

Communities of Concern

The state of Missouri 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 community[87] that could result from implementation of an action (USGS, 2010b).

The Missouri Natural Heritage Program (MNHP) 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 MNHP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Missouri. Communities ranked as an S1 by the MNHC 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 (USGS, 2010b).

Seventeen vegetative communities are ranked as S1 communities[88] in Missouri; these communities represent the rarest terrestrial habitat in the state (USGS, 2010b). These communities occur in both the Interior Highlands and Mississippi Plains regions of the state. Missouri Appendix A, Table A-1 provides a description of the S1 communities along with their distribution and associated USEPA Level III ecoregions.

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[86] 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, 2016f)

[87] 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, 2015m)

[88] S1 –" Critically imperiled in the nation or state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state. Typically 5 or fewer occurrences or very few remaining individuals. (<1,000)." (USGS, 2010b)

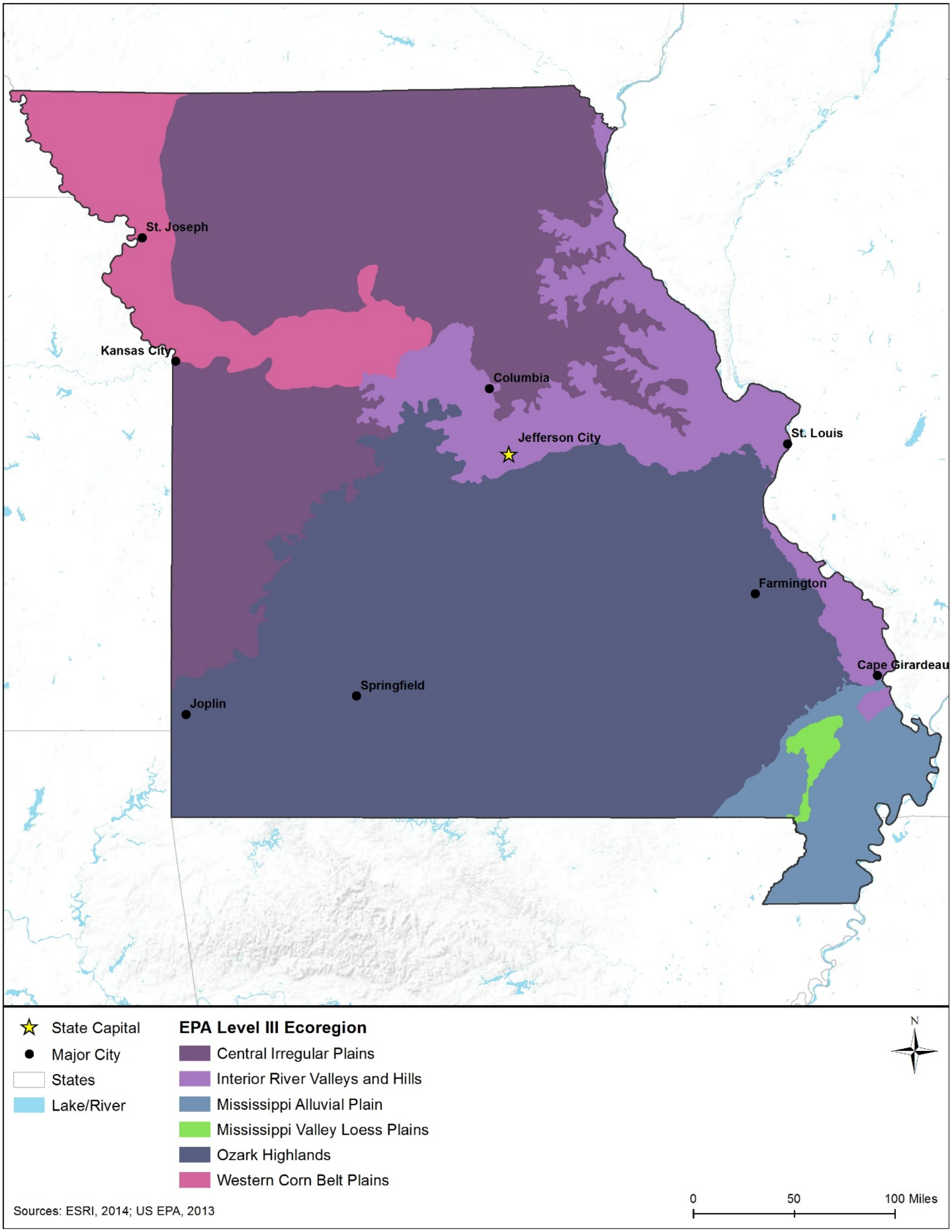

Figure 10.1.6-1: USEPA Level III Ecoregions in Missouri

Table 10.1.6-2: USEPA Level III Ecoregions of Missouri

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Interior Plains				
72	Interior River Valleys and Hills	This region is between the forested Ozark Highlands and the flatter and less forested Central Corn Belt. This glacier-carved region is characterized by wide and flat-bottomed valleys.	Beech-Maple Forests, Woodlands, Marshes and Swamps	**Hardwood Trees –** Sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*) silver maple (*Acer saccharinum*), American elm (*Ulmus rubra*), green ash (*Fraxinus pennsylvanica*), basswood (*Tilia americana*), red oak (*Quercus rubra*), eastern cottonwood (*Populus deltoids*), bitternut hickory (*Carya cordiformis*), white oak (*Quercus alba*), river birch (*Betula nigra*) **Conifer Trees** – Shortleaf pine (*Pinus echinata*)
47	Western Corn Belt Plains	This region is characterized by nearly level to gently rolling terrain including glaciated till plains and hilly loess plains. Average annual precipitation ranges from 26 to 37 inches occurring mainly during the growing season. Fertile, moist, warm soils have resulted in extensive agricultural activities, including one of the most highly productive areas globally for corn and soybeans.	Historically Tallgrass prairie, Oak savanna and woodlands, Northern floodplain forest, Oak forest; currently more than 75% of land is used to support cropland agriculture (corn, soybeans, alfalfa, and other feed grains).	**Hardwood Trees –** Plains cottonwood (*Populus deltoides sp. monilifera*), green ash, boxelder (*Acer negundo*), elm (*Ulmus spp.*), hickory (*Carya spp.*), bur oak (*Quercus macrocarpa*), basswood, black walnut (*Juglans nigra*), willow (*Salix spp.*) **Forbs and Grasses** – Big bluestem (*Andropogon gerardii*), prairie cordgrass (*Spartina pectinata*), switch grass (*Panicum virgatum*), sedges (*Cyperaceae*), Indian grass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), porcupine grass (*Hesperostipa spartea*), sideoats grama (*Bouteloua curtipendula*), prairie sandreed (*Calamovilfa longifolia*), needle and thread (*Hesperostipa comata*)
40	Central Irregular Plains	The terrain of this ecoregion is more broken up than the plains to the north but more level and less forested than land to the south and east in Missouri. Portions of this ecoregion were glaciated, resulting in generally rolling to level topography and a variety of soil types. Average annual precipitation ranges from 32 to 40 inches.	Tallgrass prairie, Oak woodlands, Cordgrass wet prairie	**Hardwood Trees –** Bur oak, white oak, Chinkapin oak (*Q. muehlenbergii*), Plains cottonwood, Green ash, Boxelder (*Acer negundo*), elm **Forbs and Grasses** – Big bluestem, prairie cordgrass, sideoats grama, little bluestem, Indian grass, switch grass, sedges, needle and thread grass

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Ozarks				
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 (*Quercus falcata*), white oak, and shagbark hickory (*Carya ovata)* **Conifer Trees –** shortleaf pine and loblolly pine (*Pinus taeda*)
Geographic Region: Coastal 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 (*Taxodium distichum*), black gum (*Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*), overcup oak (*Quercus lyrata*), water oak (*Quercus nigra*), and willow oak (*Quercus phellos*)
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, and shagbark hickory

Source: (USEPA, 2015d)

Nuisance and Invasive Plants

There are a large number of undesirable plan species that are considered nuisance and invasive[89]. 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 (Government Printing Office, 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 terrestrial, 19 aquatic, and five parasitic (USDA, 2014a).

Noxious weeds and other invasive plants pose a large threat to Missouri'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[90]. A total of 12 state-listed noxious weeds are regulated in Missouri according to MRS 263.190 and 263.200. Of these species, 11 are terrestrial and one is an aquatic species (MDA, 2015). The following species by vegetation type are regulated in Missouri.

- **Aquatic –** Purple loosestrife (*Lythrum salicaria*)
- **Terrestrial Forbs and Grasses –** Canada thistle (*Cirsium arvense L. Scop.*), common teasel (*Dipsacus fullonum L.*), cutleaf teasel (*Dipsacus laciniatus L.*), field bindweed (*Convolvulus arvensis*), Johnson grass (*Sorghum halepense*), kudzu (*Pueraria montana [Lour.] Merr.*), marijuana (*Cannabis sativa L.*), multiflora rose (*Rosa multiflora*), musk thistle (*Carduus nutans*), Scotch thistle (*Onopordum acanthium*), and spotted knapweed (*Centaurea stoebe*)

10.1.6.4. *Terrestrial Wildlife*

This section discusses the terrestrial wildlife species in Missouri, divided among mammals,[91] birds,[92] reptiles and amphibians,[93] and invertebrates.[94] Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers,[95] nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Missouri. A discussion of non-native and/or

[89] 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, 2015m)

[90] 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." (EPA 2015j)

[91] 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, 2015m)

[92] Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves." (USEPA, 2015m)

[93] 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, 2015m)

[94] Invertebrates: "Animals without backbones: e.g. insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015m)

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

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. According to the Missouri Department of Conservation website, Missouri is currently home to approximately 70 mammal species, 75 reptile species, 43 amphibian species, and 390 resident and migratory bird species (MDC, 2016a).

Mammals

Common and widespread mammalian species in Missouri 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*) and bison (*Bison bison*) are uncommon or rare in Missouri due to restricted habitat or secretive behavior (MDC, 2016b). A number of threatened and endangered mammals are located in Missouri. Section 10.1.6.6, Threatened and Endangered Species, identifies these protected species.

In Missouri, 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 birds. The following 12 species of furbearers may be legally hunted or trapped in Missouri: raccoon, red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), badger (*Taxidea taxus*), opossum, striped skunk (*Mephitis mephitis*) and river otter (*Lontra canadensis*). (MDC, 2016c)

Missouri has identified 29 mammals as Species of Greatest Conservation Concern. Section 10.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species. The SGCN list consists of at-risk species that are rare or declining, and State Wildlife Grants can provide funding for efforts to reduce their potential 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 the state of Missouri to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP). (MDC, 2016d)

Birds

The number of native bird species documented in Missouri varies according to the timing of the data collection effort, changes in bird taxonomy,[96] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., extensive forests, large rivers and lakes, plains, etc.) found in Missouri support a large variety of bird species.

[96] Taxonomy: "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2015m)

Approximately, 390 species of resident and migratory birds have been documented in Missouri, Among the 390 extant[97] species in Missouri, 50 SGCN have been identified. (MDC, 2016d)

Missouri is located within the Mississippi Flyway. Covering the entire state of Missouri, the Central Flyway spans from the Gulf of Mexico to the Canadian boreal forest. Large 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. (Ducks Unlimited, 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, 2015c). 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, 2015c).

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 year round within the state of Missouri. Golden eagles may transit through the state in small numbers in the winter. (MDC, 2012)

A number of Important Bird Areas (IBAs) have also been identified in Missouri, as can be seen in Figure 10.1.6-2. 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 (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, 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.

According to the National Audubon Society (NAS), a total of 47 IBAs have been identified in Missouri, including breeding range,[98] migratory stop-over, feeding, over-wintering areas, and a variety of habitats such as native grasslands, forests, large rivers, and wetland/riparian[99] areas (NAS, 2015). These IBAs are widely distributed throughout the state, although the largest concentration of IBAs are located in the south and east regions of the state. Many of these IBAs

[97] Extant: "A species that is currently in existence (the opposite of extinct)." (USEPA, 2015m)

[98] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared" (USEPA, 2015v).

[99] Riparian: "Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands." (EPA 2015r).

are existing public lands within the state that contain native grasslands and wetlands. These habitats are an important migration stop and breeding ground for many waterfowl species.

A number of threatened and endangered birds are located in Missouri. Section 10.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Reptiles and Amphibians

In 2010, approximately 126 native reptile and amphibian species were believed to occur in Missouri (MDC, 2010a). These species occur in a wide variety of habitats, from the upland hardwoods in the northwest to the Mississippi alluvial plain in the southeast. Many of these species are widespread throughout the state. Of the 126 native reptile and amphibian species, 34 SGCN have been identified (MDC, 2010a).

In the state of Missouri, the common snapping turtle (Chelydra serpentina), softshell turtles (*Trionychidae*), bull frog (*Lithobates catesbeianus*), and green frog (*Rana clamitans*) are classified as non-game aquatic species and are allowed to be taken in accordance with the MDC state hunting regulations (MDC, 2015k) (MDC, 2015l). All other reptile and amphibian species in the state of Missouri are classified as nongame species.

One endangered amphibian is located in Missouri. Section 10.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Invertebrates

Missouri 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. In the United States, one third of all agricultural output depends on pollinators[100]. 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" (NRCS, 2009). Currently, Missouri lists approximately 121 species of insects, arachnids, and millipedes listed as SGCN (MDC, 2010a).

A number of threatened and endangered invertebrates are located in Missouri. Section 10.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[100] Pollinators: "Animals or insects that transfer pollen from plant to plant." (USEPA, 2015m)

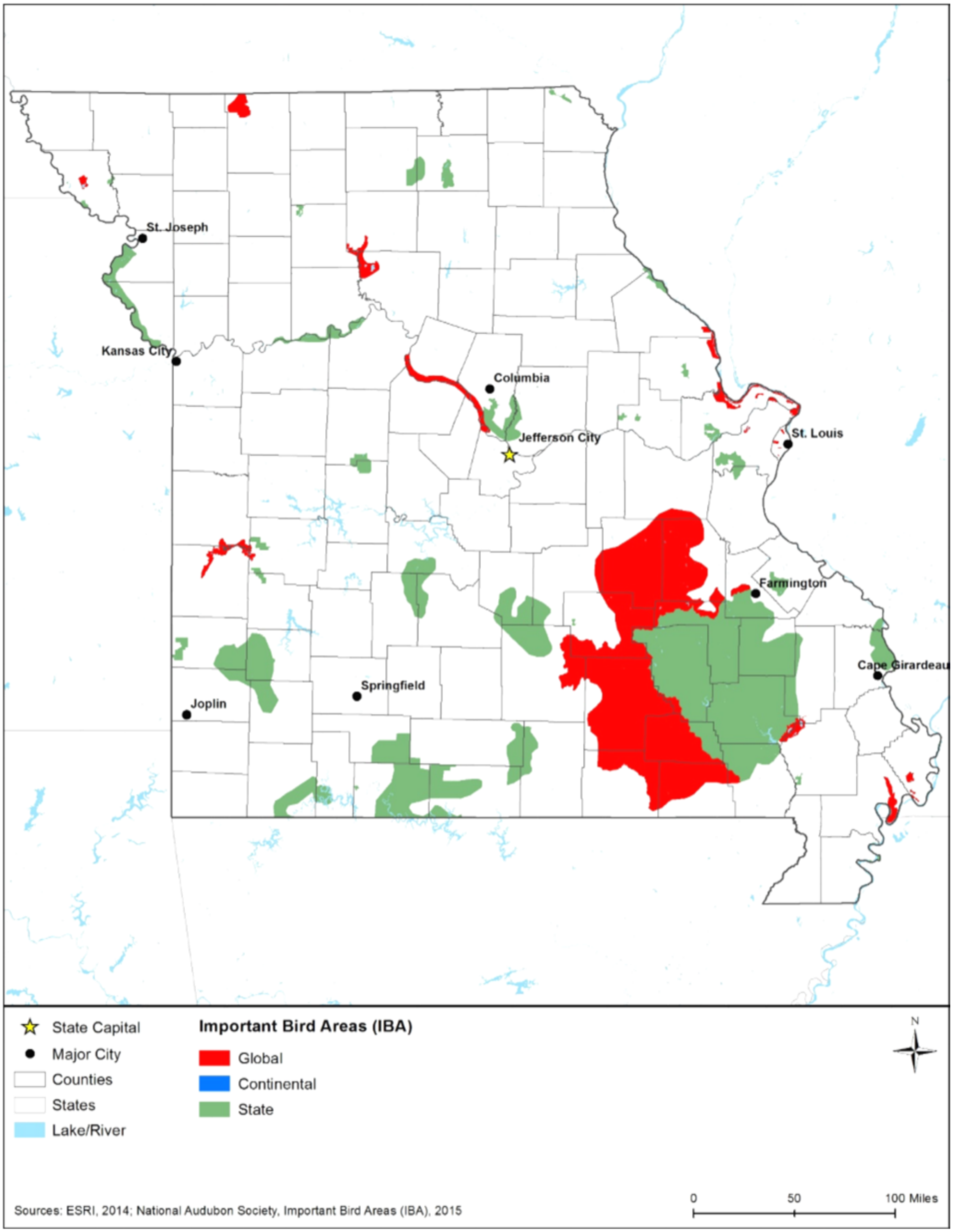

Figure 10.1.6-2: Important Bird Areas (IBA) of Missouri

Invasive Wildlife Species

Nuisance species are frequently non-native or invasive species that can damage the natural environment. Examples of non-native or invasive wildlife species in Missouri include feral hogs (*Sus scrofa*) or European starlings (*Sternus vulgaris*). Feral hogs adversely impact several native large and small mammals. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and can carry/transmit disease to livestock and humans (MDC, 2015m). European starlings can impact native birds by aggressively competing for tree cavities (MDC, 2016e).

Missouri has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select terrestrial wildlife species. MDC maintains a list of prohibited[101] species. This lists are presented in MRS 10-4.117 Prohibited Species. In addition, Missouri has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of plant pests (MRS 263.130.1). Invasive insects pose a large threat to Missouri's forest and agricultural resources. To date, the regulation targets all plant pests of Missouri and is not aimed at a select few. 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. Currently, federal quarantines are in place that restrict the transport of plant materials with the potential to contain the emerald ash borer (USDA, 2014a).

10.1.6.5. *Fisheries and Aquatic Habitat*

This section discusses the aquatic wildlife species in Missouri, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Missouri landscape with regard to aquatic wildlife is the large river ecosystems found in the state. 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 the state of Missouri (NOAA, 2016).

Critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Missouri and is discussed in Section 10.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

Missouri is home to approximately 200 species of freshwater fish, ranging in size from small darters and minnows to larger species such as gar. Among these species are several important recreational and game fish, such as yellow perch, walleye, catfish, sunfishes, bass, northern pike, and several species of trout. Of the extant fish species in Missouri, a number are listed as federally threatened and endangered, as identified in Section 10.1.6.6, Threatened and

[101] Prohibited species: "live, exotic wildlife species, subspecies, or hybrid of that species, including viable embryos or gametes, that may not be possessed, sold, purchased, exchanged, or transported in Arkansas, except as provided in MCA 87-5-709 or ARM 12.6.2220" (MFWP 2015).

Endangered Species and Species of Conservation Concern. Sixty-eight of these species are listed as SGCN (MDC, 2010a).

Shellfish and Other Invertebrates

Missouri is home to an unknown number of mollusk and crustacean species, including a multitude of freshwater mussels and crayfish. Twenty-eight species of freshwater mussels, 17 crayfish, and 31 species of other crustaceans are listed as SGCN. Many of these species are found in the Mississippi River. River diversions and impoundments are a primary threat to Missouri's native mussel species. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other well-known Missouri freshwater invertebrates include a variety of fairy shrimp, amphipods, and pillbug species (MDC, 2010a).

Invasive Aquatic Species

Missouri has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase, and introduction of select aquatic invasive species. MDC maintains a list of prohibited exotic species. According to MSR 10-4.117 Prohibited Species, it is illegal to import, transport, or possess the following species.

- **Fish –** black carp (*Mylopharyngodon piceus*), round goby (*Neogobius melanostomus*), tubenose goby (*Proterorhinus semilunaris*), snakehead fish (genera *Channa or Parachanna*), and walking catfish (family *Clariidae*)
- **Aquatic Invertebrates –** New Zealand mudsnail (*Potamopyrgus antipodarum*), rusty crayfish (*Orconectes rusticus*), marbled crayfish (*Procambarus marmorkrebs*), Australian crayfish (genus *Cherax*), mitten crabs (genus *Eriocheir*), zebra mussels (*Dreissena polymorpha*), quagga mussels (*Dreissena rostriformis [bugensis]*), and mystery snails (genus *Cipangopaludina*).

10.1.6.6. *Threatened and Endangered Species and Species of Conservation Concern*

The USFWS is responsible for administering the ESA (16 U.S.C. §1531 et seq.) in the state of Missouri. The USFWS Great Lakes Office has identified 23 federally endangered and 14 federally threatened species known to occur in Missouri (USFWS, 2015d). Of these 37 federally listed species, five of them have designated critical habitat[102] (USFWS, 2015e). One candidate species[103] is identified by USFWS as occurring within the state (USFWS, 2015d). Candidate species are not afforded statutory protection under the ESA; however, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014b). The 37 federally listed species include 4 mammals, 3

[102] 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))

[103] Candidate species are plants and animals that the USFWS has "sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities." (USFWS 2014a)

birds, 6 fish, one amphibian, 14 invertebrates, and 9 plants (USFWS, 2015d), 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 would be required.

Mammals

There are three endangered and one threatened mammal species that are federally listed and known to occur in the state of Missouri as summarized in Figure 10.1.6-3. The gray bat (*Myotis grisescens*) is mostly found south of the Missouri River in the southern part of the state (MDC, 2016f). Eight-five percent of the Indiana bat (*Myotis sodalist*) population in Missouri is found in eight counties, mainly in the northern part of the state (MDC, 2016g). Northern long-eared bat (*Myotis septentrionalis*) can be found throughout the state, while the Ozark Big-eared bat (*Corynorhinus townsendii ingens*) is found in the southwestern region of the state in the James River basin (MDC, 2016h). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided.

Table 10.1.6-3: Federally Listed Mammal Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Gray Bat	*Myotis grisescens*	E	No	Limestone karst throughout the state.
Indiana Bat	*Myotis sodalis*	E	Yes (specific caves in Crawford, Franklin, Shannon, Washington, and Iron Counties)	Trees and snags, caves, and abandoned mines; found throughout the state.
Northern Long-eared Bat	*Myotis septentrionalis*	T	No	Trees and snags, caves, and abandoned mines; found throughout the state.
Ozark Big-eared Bat	*Corynorhinus townsendii ingens*	E	No	Limestone karst within mature hardwoods located in southwestern Missouri.

[a] E = Endangered, T = Threatened

Source: (USFWS 2015a).

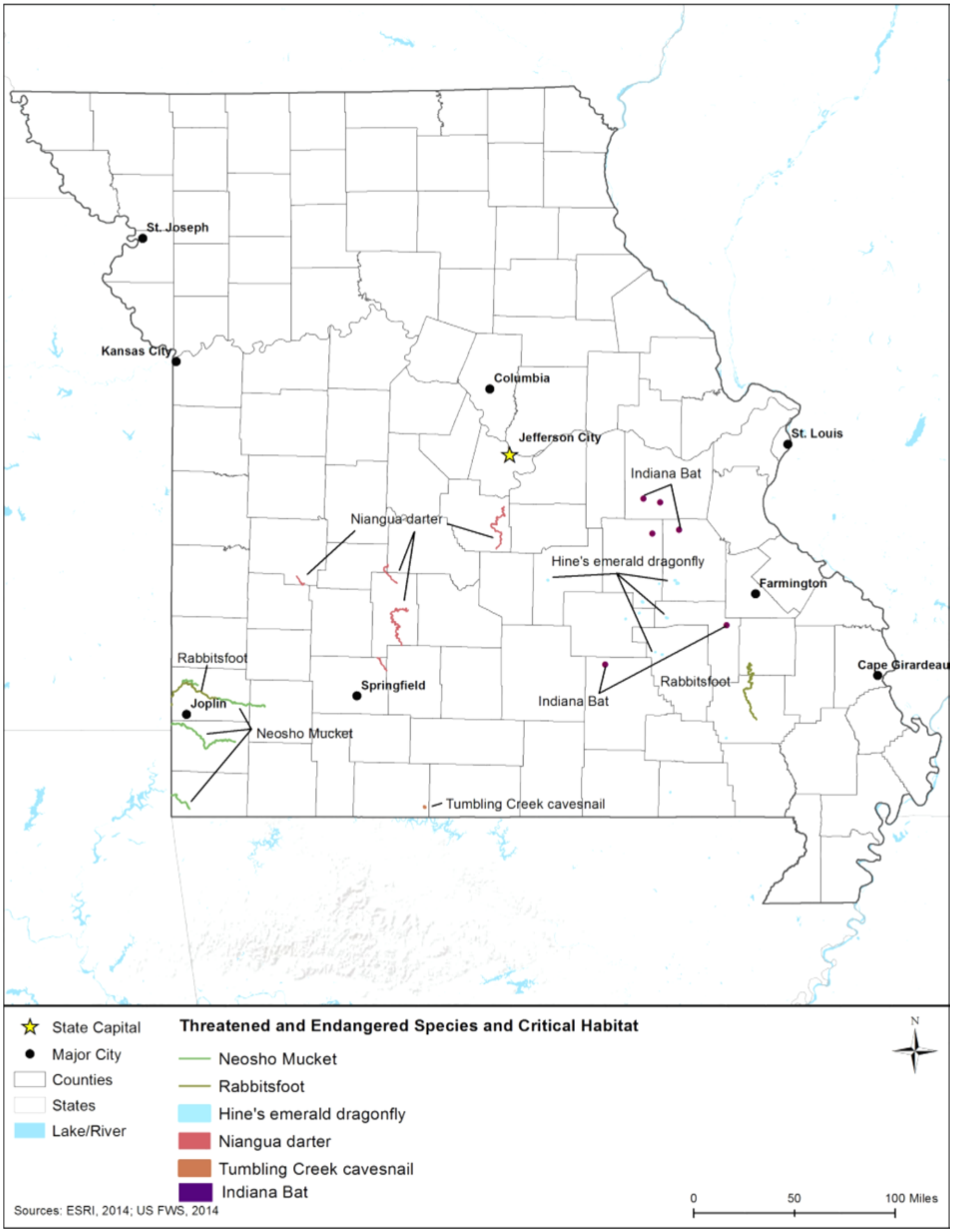

Figure 10.1.6-3: ESA Designated Critical Habitat in Missouri Mammals

Gray Bat. The gray bat is a medium-sized, insectivorous bat weighing approximately 7 to 16 grams and it is longer than any other Myotis. Gray bats have dark gray fur after molt in July or August and then the fur transitions to a chestnut brown. This species was 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). In Missouri, the gray bat is believed or known to occur in 102 counties throughout the state (USFWS, 2016a).

The gray bats live 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).

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, 2015f). The Indiana bat was originally federally listed as being in danger of extinction[104] 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, 2016b). Regionally, this species is currently found in the central portion of the eastern U.S., from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Missouri, the Indiana bat is believed or known to occur in every county in the state (USFWS, 2016c). Critical habitat has been designated in specific caves in several counties in Missouri: Onyx Cave, Crawford County; Cooper Hollow Sink Cave and Bear (Mud Sink) Cave, Franklin County; Pilot Knob Mine, Iron County; Great Scott Cave, Washington County; and Bat Cave, Shannon County (USFWS, 2015g).

Grey 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 hibernation sites (within 10 miles) before they migrate to their summer habitats, where the females roost (USFWS, 2016b). Some of these summer habitats can be as far as 200 miles away from their hibernation areas (USFWS 2004a). Indiana bats roost in trees during the day and feed at night in a variety of habitats, although

[104] Extinction: "The disappearance of a species from part or all of its range." (USEPA, 2015m)

streams, floodplain forests, ponds, and reservoirs are preferred. Females roost together in maternity colonies under the loose bark of dead or dying trees, or under the loose bark of shaggy-barked trees, although the physical characteristics of individual trees appear to be more of a factor than the species of tree. Nevertheless, tree species that have been noted as preferred by Indiana bat include shagbark hickory (*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*) (NatureServe Explorer, 2015).

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 (USGS-NWHC, 2015).

Northern Long-eared Bat. The northern long-eared bat is a brown, furred, insectivorous bat with long ears. This bat is medium-sized, relative to other members of the genus Myotis, reaching a total length of 3 to 3.7 inches in length (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 (USFWS, 2015h). In Missouri, the northern long-eared bat is believed or known to occur in every county in the state (USFWS, 2015be).

This species hibernates in caves and mines that exhibit constant temperatures, high humidity, and no 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 U.S. 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; the ears are over 2.5 centimeters in length. The Ozark big-eared bats have light to dark brown fur, the shade varies based on age and subspecies. This species was 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 Missouri, the Ozark big-eared bat is believed or known to occur in two counties in the southwestern region of the state. (USFWS, 2015i)

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 (USFWS, 1997b).

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, 1997b). 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 is one endangered and two threatened avian species that are federally listed and known to occur in the state of Missouri as summarized in Table 10.1.6-4. The least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*) are found close to water throughout Missouri. There is one candidate species in the state, the red-cockaded woodpecker (*Leuconotopicus borealis*). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided below.

Table 10.1.6-4: Federally Listed Bird Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Least Tern	*Sterna antillarum*	E	No	Unvegetated sandbars along the Missouri and Mississippi Rivers in Missouri.
Piping Plover	*Charadrius melodus*	T	No	Sandy Shorelines along the Missouri and Mississippi Rivers in Missouri.
Red Knot	*Calidris canutus rufa*	T	No	Manmade freshwater habitats and lakes throughout Missouri.

[a] E = Endangered, T = Threatened

Source: (USFWS 2015a).

Least Tern. The least tern is a grey and white gull with black markings on its head that reaches nine inches in length. The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The least tern is a summer resident in Missouri and breeds along several major river systems in the U.S., which include the Missouri, Mississippi, Ohio, Red, and Rio Grande Rivers (MDC, 2015n). Specifically in Missouri, the Mississippi and Missouri Rivers have hosted breeding populations, although today they only occur on the Mississippi (MDC, 2015n). In Missouri, the least tern is believed or known to occur in 37 counties which occur along the Missouri River and Mississippi River (USFWS, 2015j).

Suitable habitat for least terns consists of relatively 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, 2015k) (USFWS 2014b). The primary causes of habitat loss historically have been dam construction, recreational activities, and the alteration of flow regimes along major river systems (USFWS, 2015k).

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

Piping plover Photo Credit: USFWS

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, 1996a). During migration, plovers use inland and riverine sites throughout the U.S. as stopover habitat (USFWS, 2015o). In Missouri, the piping plover is known or believed to occur in 33 counties along the Missouri River and Mississippi River (USFWS, 2016d).

This species feeds on worms, fly larvae, beetles, crustaceans, and other macroinvertebrates (USFWS, 2015m). They prefer habitat that is wide, open, and made of 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, 2003a).

Red Knot. The red knot is a medium-sized shorebird; it is approximately 9 inches in length with a wingspan up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005a). This species was listed as threatened in 2014 (79 FR 73705 73748, December 11, 2014).

The red knot migrates annually from its breeding grounds above the Arctic Circle to the tip of South America where it winters. This species will typically migrate along the Atlantic and Pacific coastlines; however, occasionally individuals may migrate through the interior of the United States. In Missouri, the red knot is believed or known to occur in 34 counties throughout the state (USFWS, 2015p). This species is a “rare transient” in the state of Missouri and has been recorded around Horseshoe Lake, the Mississippi River, the Swan Lake National Refuge, and Squaw Creek National Wildlife Refuge (USFWS, 2005a).

Red knots eat mussels and other mollusks mostly all year (USFWS, 2005a). Current threats to the red knot include sea level rise, climate change, and reduced food availability at their migration stopover sites (USFWS, 2013a).

Fish

There are three endangered and three threatened fish species federally listed and known to occur in Missouri as summarized in Table 10.1.6-5. The Ozark cavefish (*Amblyopsis rosae*) and grotto sculpin (*Cottus specus*) occur primarily in cave habitats in Missouri. The Neosho madtom (*Noturus placidus*) occurs in the southwestern region of Missouri, while the Niangua darter (*Etheostoma nianguae*) occurs in the central region Missouri. The Topeka shiner (*Notropis topeka*) occurs in the northern region of the state and the pallid sturgeon (*Scaphirhynchus albus*) can be found throughout the state (MDC, 2016i). There is one candidate species in the state, the Arkansas darter (*Etheostoma cragini*). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided below.

Table 10.1.6-5: Federally Listed Fish Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Grotto Sculpin	*Cottus specus*	E	No	Cave streams and surface streams in Perry County, Missouri.
Neosho Madtom	*Noturus placidus*	T	No	Shallow riffle areas above gravel substrate in Jasper County, Missouri.
Niangua Darter	*Etheostoma nianguae*	T	Yes	Shallow pools and runs in the Osage River Basin in central Missouri.
Ozark Cavefish	*Amblyopsis rosae*	T	No	Groundwater habitats of the Springfield Plateau Aquifer in southwestern Missouri.
Pallid Sturgeon	*Scaphirhynchus albus*	E	No	Bottom of dynamic channels of the Missouri and Mississippi Rivers in Missouri.
Topeka Shiner	*Notropis topeka*	E	No	Small clean pools in prairie streams; found in the northern half of Missouri.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2015r)

Grotto Sculpin. The grotto sculpin is a small fish with a total body length of approximately 2.5 inches (USFWS, 2015t). This species has very limited eyesight and lacks pigment (USFWS, 2012a). This species was listed as endangered in 2013 (78 FR 58938 58955, September 25, 2013). This species is believed or known to occur in Perry County, Missouri (USFWS, 2015t). In Perry County, the grotto sculpin is limited to Blue Spring Branch and the Cinque Hommes drainage (USFWS, 2012a).

Grotto sculpin - Photo credit: USFWS

The grotto sculpin inhabits cave streams, resurgences[105], and surface streams. Adults occur within cave streams, while juveniles occur primarily within resurgences and surface streams (USFWS, 2012a). Habitat requirements for this species include consistent water flow, organic input, and connections to surface streams (USFWS, 2012a). The primary threat to this species is water contamination due to illegal dumping, agricultural runoff and waste, urban development, sedimentation, and sand mining (USFWS, 2012a).

Neosho Madtom. The Neosho madtom is a small fish in the catfish family with a total body length of approximately 3 inches (USFWS, 1991a). This species exhibits mottled coloring on the body and dark vertical lines on the tail fin (USFWS, 1991a). The Neosho madtom was listed as threatened in 1990 (55 FR 21148 21153, May 22, 1990). Regionally, this species is believed or known to occur in Kansas, Missouri, and Oklahoma (USFWS, 2015u). In Missouri, this species is believed or known to occur within the Spring River in Jasper County (USFWS, 2013b) (USFWS, 2015u).

The Neosho madtom typically inhabits shallow riffle areas above gravel substrate. This species is nocturnal and spends most of the day hidden in the gravel substrate. Major threats to the Neosho madtom include habitat loss and degradation due to gravel mining, dredging, dams, and pollution. (USFWS, 2013b)

Niangua Darter. The Niangua darter is a small fish measuring 3 to 4 inches in total length (MDC, 2015o). This species is yellowish-olive in color and exhibits orange spots and eight dark vertical bars along its body (USFWS, 1989a). Distinguishing features include two dark spots at the base of the tail fin and alternating greenish blotches and orange bars on its sides (MDC, 2015o). This species was listed as threatened in 1985 (50 FR 24649 24653, June 12, 1985).

Regionally, this species is believed or known to occur in 12 counties in central Missouri (USFWS, 2015v). In Missouri, the Niangua darter is found within the Osage River Basin (USFWS, 1989a). In 1985, critical habitat was designated in Missouri for this species (50 FR

[105] Resurgences are "the point of emergence of a cave stream from the cave system and are an interface between strictly subterranean habitats (caves) and streams that flow only on the surface." (USFWS 2012b)

24649 24653). Portions of the Niangua River, Big Tavern Creek, Little Niangua River, Pomme de Terre River, and Brush Creek were chosen as critical habitat for the Niangua darter (USFWS, 1985a).

Suitable habitat for the Niangua darter consists of waterways that drain hilly areas and contain shallow pools and runs that have clear water, slow to moderate flow, and gravel substrates free of silt (MDC, 2015o) (USFWS, 1989a). Major threats to this species include habitat loss and degradation due to reservoir construction, runoff, increased sedimentation, and stream channelization (MDC, 2015o) (USFWS, 1989a).

Ozark Cavefish. The Ozark cavefish 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, 2015w) (USFWS, 2011a). The Ozark cavefish was 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 (USFWS, 2011a). In Missouri, this species is believed or known to occur in 22 caves in the southwestern region of the state (USFWS, 2011a) (USFWS, 2015w). 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 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 80 pounds. The pallid sturgeon has a flattened snout and the part of the body just before the tail (caudal peduncle) is armored with cartilage plates (USFWS, 2015x) (USFWS, 1998). This species was listed as endangered in 1990 (55 FR 36641 36647, September 6, 1990).

The species' range extends the length of the Missouri and Mississippi Rivers (USFWS, 2015x). In Missouri, the pallid sturgeon is believed or known to occur in 35 counties of the state (USFWS, 2015x). 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, 2014c).

Topeka Shiner. The Topeka shiner is a silvery minnow with a dark stripe on its side, and grows to approximately 3 inches in length (USFWS, 2013c). The species was listed as endangered in 1998 (63 FR 69008 69021, December 15, 1998). The Topeka shiner is known to occur in portions of South Dakota, Minnesota, Kansas, Iowa, Missouri, and Nebraska (USFWS, 2015y). The Topeka shiner occurs primarily along small prairie streams in pools containing clear, clean water, clean gravel, rock, or sand bottoms (USFWS, 2013c).

In Missouri, the Topeka shiner is believed or known to occur in eighteen counties in the northern half of the state (USFWS, 2015y). Topeka shiner populations in Missouri are small and isolated, occurring only in the Missouri River basin (USFWS, 2013c). The only viable populations left in Missouri can be found in the Moniteau Creek headwaters and the Sugar Creek headwaters (USFWS, 2013c).

In 2013, a non-essential experimental population was established in Missouri (78 FR 42702 42718, July 17, 2013). Reintroduction sites included the Little Creek headwaters, East Fork Muddy Creek, and tributaries of Spring Creek (USFWS, 2013c). Threats to the species include alterations to stream quality such as increases in sedimentation and nutrients from fertilizers, changes in stream flow volume or temperatures, and restricted access for species river movement and isolation of populations (USFWS, 2010a).

Amphibians

One endangered amphibian species is federally listed and known to occur in the state of Missouri as summarized in Table 10.1.6-6. The Ozark hellbender (*Cryptobranchus alleganiensis bishopi*) is found throughout the White River watershed in southern Missouri. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided below.

Table 10.1.6-6: Federally Listed Amphibian Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Ozark Hellbender	*Cryptobranchus alleganiensis bishopi*	E	No	Clear and cool waters in southern Missouri.

[a] E = Endangered

Source: (USFWS 2015a).

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, 2015z). The Ozark hellbender was listed as endangered in 2011 (76 FR 61956 61978, October 5, 2011).

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

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, 2015aa).

Invertebrates

Thirteen endangered and one threatened invertebrate species are federally listed and known to occur in the state of Missouri as summarized in Table 10.1.6-7. The cave crayfish (*Cambarus aculabrum*), Tumbling Creek cavesnail (*Antrobia culveri*), and Neosho mucket (*Lampsilis rafinesqueana*) occur in the southwestern region of Missouri. The winged mapleleaf (*Quadrula* *fragosa*), fat pocketbook (*Potamilus capax*), and sheepnose mussel (*Plethobasus cyphyus*) occur in eastern Missouri. The Hine's emerald dragonfly (*Somatochlora hineana*), snuffbox mussel (*Epioblasma triquetra*), and Curtis pearlymussel (*Epioblasma florentina curtisii*) occur in the southeastern region of Missouri, while the Higgins eye pearlymussel (*Lampsilis higginsii*) occurs in the northeastern region of the state. The rabbitsfoot (*Quadrula cylindrica*) and scaleshell mussel (*Leptodea leptodon*) occur in southern Missouri. The spectaclecase mussel (*Cumberlandia monodonta*) and pink mucket pearlymussel (*Lampsilis abrupta*) occur throughout the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided below.

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

Regionally, this species is known to occur in northwestern Arkansas and southwestern Missouri (USFWS, 2015ab). In Missouri, the cave crayfish is believed or known to occur in McDonald County (USFWS, 2015ab). 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, 2013d).

Table 10.1.6-7: Federally Listed Invertebrate Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Cave Crayfish	*Cambarus aculabrum*	E	No	Caves with low light and temperature in McDonald County, Missouri.
Curtis Pearlymussel	*Epioblasma florentina curtisii*	E	No	Riffles and runs within transitional streams in southeastern Missouri.
Fat Pocketbook	*Potamilus capax*	E	No	Streams, tributaries, and channels in northeastern and southeastern Missouri.
Higgins Eye Pearlymussel	*Lampsilis higginsii*	E	No	Deep, moderately flowing rivers with firm, loose riverbeds in Marion County, Missouri.
Hine's Emerald Dragonfly	*Somatochlora hineana*	E	No	Marshes and slow moving water next to forests in southeastern Missouri.
Neosho Mucket	*Lampsilis rafinesqueana*	E	Yes	Riffles and runs within the Arkansas River system in southwestern Missouri.
Pink Mucket Pearlymussel	*Lampsilis abrupta*	E	No	Riffle areas, with a moderate current and mud or sand substrates, throughout Missouri.
Rabbitsfoot	*Quadrula cylindrica*	T	Yes	Shallow areas of streams and rivers, with sand and gravel along the banks; found in southwestern and southeastern Missouri.
Scaleshell Mussel	*Leptodea leptodon*	E	No	Stable riffles and runs, where freshwater drum is present; found in the central and southern regions of Missouri.
Sheepnose Mussel	*Plethobasus cyphyus*	E	No	Shallow shoal areas above coarse sand or gravel in eastern Missouri.
Snuffbox Mussel	*Epioblasma triquetra*	E	No	Rivers with swift currents and sandy/gravel bottoms; found in southeastern Missouri.
Spectaclecase Mussel	*Cumberlandia monodonta*	E	No	Sheltered areas in large rivers throughout the state.
Tumbling Creek Cavesnail	*Antrobia culveri*	E	Yes	One stream within the Tumbling Creek Cave in Taney County, Missouri.
Winged Mapleleaf	*Quadrula fragosa*	E	No	Large streams with mud or gravel bottoms in Franklin County, Missouri.

[a] E = Endangered, T = Threatened

Source: (USFWS, 2015r)

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 since 1993 (USFWS, 2010b).

Suitable habitat for the Curtis pearlymussel consists of shallow, stable rifles 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, 2010b).

Fat Pocketbook. The fat pocketbook is a mussel with a globose shell. This species has as smooth shell that is typically yellowish brown and lacks rays (USFWS, 1989b). 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 (USFWS, 2015ac). In Missouri, the fat pocketbook is believed or known to occur in six counties in the northeastern and southeastern regions of the state (USFWS, 2015ac). This species is typically found in streams, tributaries, and channels with sand, mud, or gravel, or substrates (USFWS, 2007).

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

Higgins Eye Pearlymussel. The Higgins eye pearlymussel is a mussel that exhibits a shiny, olive to yellowish-green shell with irregular growth lines and green rays. Males have a more pointed posterior than females (USFWS, 2004b). This species was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976). Regionally, this species is believed or known to occur in Illinois, Iowa, Minnesota, Missouri, South Dakota, and Wisconsin. In Missouri, the Higgins eye is found only in Marion County (USFWS, 2015ad).

The species is usually found in mussel beds with at least 15 other types of mussels, in portions of large rivers with firm, loose bottoms such as sand and gravel, and not clay or concrete (USFWS, 2004b). The river environment should be deep with a moderate flow. The primary limiting factor to the Higgins eye pearlymussel is the threat of invasive species such as the Zebra mussel, which has intensively impacted mussel communities in various locations throughout the species' range (USFWS, 2004b).

Hine's Emerald Dragonfly. The Hine's emerald dragonfly is a dark green dragonfly with two cream-colored horizontal lines and bright green eyes. The species grows to approximately 2.5 inches and may have translucent, yellowish-brown fringed wings (USFWS, 2001). The Hine's emerald dragonfly was listed as endangered in 1995 (60 FR 5267 5273, January 26, 1995). Regionally, this species occurs in Illinois, Michigan, Missouri, and Wisconsin. In Missouri, the Hine's emerald dragonfly is believed or known to occur in five counties in the southeastern region of the state (USFWS, 2016e).

Hine's Emerald Dragonfly
Photo credit: USFWS

Habitat for Hine's emerald dragonfly include marshes and sedge meadows fed by calcium-rich groundwater seepage on top of sedimentary bedrock, in locations with slow moving water next to forests (USFWS, 2001). In 2010, critical habitat for this species was designated in Wisconsin and Michigan (75 FR 21394 21453). Threats to this dragonfly primarily include habitat loss due to agriculture and human development, successional habitat progression, and alterations to biological and hydrological systems (USFWS, 2001).

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, 2015ae). 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 (USFWS, 2015af). In Missouri, this species is believed or known to occur in six counties in the southwestern region of the state (USFWS, 2015af). 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, 2015ae).

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). In Missouri, critical habitat consists of segments of the Elk River, Shoal Creek, Spring River, and North Fork Spring River (USFWS, 2015ae). Threats to this species include habitat loss and degradation due to development, agricultural operations, and treated wastewater releases (USFWS, 2015ae).

Pink Mucket Pearlymussel. The pink mucket is a medium-sized mussel that can grow up to 4 inches in length. The shell is yellow to yellowish-brown in color (USFWS, 1985b). Females have a broadly rounded posterior, while males have a slightly pointed posterior (USFWS, 1985b). 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 Missouri, this species is believed or known to occur in 13 counties throughout the state (USFWS, 2015ag). Suitable habitat for the pink mucket consists of riffle areas in rivers that exhibit a moderate current and mud or sand substrates (USFWS, 1985b) (USFWS, 2015ah).Threats to the survival of this species include habitat loss and degradation due to water impoundment, increased erosion, and agricultural/industrial runoff (USFWS, 2015ah).

Rabbitsfoot. The rabbitsfoot mussel is a medium- to large-sized mussel that 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, 2015ai). The rabbitsfoot mussel 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 Missouri, this species is known or believed to occur in five counties in the southwestern and southeastern regions of the state (USFWS, 2015ai). 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 (USFWS, 2015ai). For reproduction this species prefers stable and undisturbed habitats with a sufficient population of host fish (USFWS, 2015ai).

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 Missouri consists of segments of the Spring River and St. Francis River (USFWS, 2015ae). 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, 2012b).

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, 2010c). 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, 2010c). In Missouri, the species is believed or known to occur in 28 counties in the central and southern regions of the state (USFWS, 2015aj).

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 (USFWS, 2010c). The scaleshell mussel is typically found in a variety of substrates within the stable riffles and runs of medium to large rivers (USFWS, 2010c).

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, 2010c).

Sheepnose Mussel. The endangered sheepnose mussel is a medium-sized freshwater mussel that usually grows to about five inches in length. This species has a shell that is a light yellow to dull yellowish brown with darker ridges (USFWS, 2012c). The sheepnose mussel was listed as endangered in 2012 (77 FR 14914 14949, March 13, 2012). This species historically occurred mostly along the Mississippi River, but has been eliminated from two-thirds of the area where it once occurred and now only occurs in 25 streams (USFWS, 2012c) (USFWS, 2015ak). In Missouri, the species is believed or known to occur in nine counties, primarily along the east side of the state (USFWS, 2015ak).

This species inhabits large rivers and streams with moderate to swift currents and feeds on suspended algae, bacteria, detritus, and microscopic animals. This species prefers shallow shoal habitats above coarse sand and gravel. For reproduction, the sheepnose prefers a stable undisturbed habitat with the presence of sauger (Sander Canadensis), its only host fish. Threats include sedimentation, dams that restrict natural flow, habitat reduction, water quality degradation, contaminations of nutrients, and invasive species of zebra mussels (Dreissena polymorpha) (USFWS, 2015ak).

Snuffbox Mussel. The snuffbox mussel is a small- to medium-sized mussel that is approximately 1.8 to 2.8 inches in length. This species has a yellow, green, or brown triangular shell with green rays (USFWS, 2015al). The snuffbox mussel was listed as endangered in 2012 (77 FR 8632 8665, February 14, 2012). The snuffbox total population has been reduced by 62 percent from its historical range and currently only occurs in 79 streams and 14 rivers compared to 210 streams and lakes in its historical range (USFWS, 2012d). In Missouri, this species is believed or known to occur in portions of Meramec River, Bourbeuse River, St. Francis River, and Black River (USFWS, 2012d).

The snuffbox mussels typically inhabit small- to medium-sized creeks, lakes, and rivers and feed on suspended algae, bacteria, and dissolved organic material. This species prefers shoal habitats with swift current over sand and gravel as they usually burrow deep in sand. Current threats to this species include sedimentation, pollution and water quality degradation, dams that restrict natural flow, and invasive non-native species of zebra mussels (USFWS, 2012d).

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

Today the spectaclecase mussel has suffered a 55 percent decrease in distribution and only occurs in 20 of the 44 streams it once inhabited. Most populations are now fragmented and limited to short reaches of streams in the 12 states it occurs: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Minnesota, Missouri, Tennessee, Virginia, West Virginia, and Wisconsin (USFWS, 2012e) (USFWS, 2015am). In Missouri, the spectaclecase mussel is believed or known to occur in 20 counties throughout the state (USFWS, 2015am).

Suitable habitat for the spectaclecase mussel include 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 (USFWS, 2012e). The current major threat to the survival of this species are 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 this species (USFWS, 2012e).

Tumbling Creek Cavesnail. The Tumbling Creek cavesnail is a small (0.09 inches tall) aquatic snail that lacks sight (USFWS, 2003b). The body of the snail is white and the shell is pale yellow (USFWS, 2003b). This species was listed as endangered in 2002 (67 FR 52879 52889, August 14, 2002). The Tumbling Creek cavesnail is only known to occur in Taney County, Missouri (USFWS, 2015an). More specifically, this species can only be found in one stream within the Tumbling Creek Cave (USFWS, 2003b). In 2011, the entire length of Tumbling Creek was designated as critical habitat for the Tumbling Creek cavesnail (76 FR 37663 37677, June 28, 2011).

This cavesnail is typically found on rocks on top of gravel substrate and usually occur near large deposits of bat guano (USFWS, 2003b). The primary threat to this species is reduced water quality caused by erosion, siltation, and pollution occurring in the cave’s recharge area (USFWS, 2003b) (USFWS, 2011b). Increased silt within the Tumbling Creek Cave can negatively impact this species by reducing the amount of suitable habitat within the cave and smothering egg deposits (USFWS, 2011b).

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 (Vaughan, 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, 2016f) 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) (Vaughan, 1997). In 2001, The Fish and Wildlife Service created 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, the Fish and Wildlife Service 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 Missouri, the species is believed or known to occur in Franklin County (USFWS, 2015ao).

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 (Vaughan, 1997).

Plants

Two endangered and seven threatened plant species are federally listed and known to occur in the state of Missouri as summarized in Table 10.1.6-8. The eastern prairie fringed orchid (*Platanthera leucophaea*), western prairie fringed orchid (*Platanthera praeclara*), decurrent false aster (*Boltonia decurrens*), and Mead’s milkweed (*Asclepias meadii*) occur primarily in prairie habitats. The Virginia sneezeweed (*Helenium virginicum*) and pondberry (*Lindera melissifolia*) occur in habitats that are seasonally flooded, while the running buffalo clover (*Trifolium stoloniferum*) occurs in mesic habitats. The Missouri bladderpod (*Physaria filiformis*) occurs in limestone glades and earthfruit (*Geocarpon minimum*) occurs in sandstone glades or upland prairies. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Missouri is provided below.

Table 10.1.6-8: Federally Listed Plant Species of Missouri

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Missouri	Habitat Description
Earth Fruit	*Geocarpon minimum*	T	No	Sandstone glades or outcrops of upland prairies in southwestern Missouri.
Decurrent False Aster	*Boltonia decurrens*	T	No	Prairie wetlands with moist, sandy soils in eastern and southern Missouri.
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	T	No	Wetlands and prairies with full sunlight; found in Carter, Grundy, and Ralls counties, Missouri.
Mead's Milkweed	*Asclepias meadii*	T	No	Tallgrass prairies adapted to drought and fire throughout Missouri.
Missouri Bladderpod	*Physaria filiformis*	T	No	Shallow soils of limestone glades in southwestern Missouri.
Pondberry	*Lindera melissifolia*	E	No	Seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions in southeastern Missouri.
Running Buffalo Clover	*Trifolium stoloniferum*	E	No	Disturbed mesic habitats with filtered sunlight throughout Missouri.
Virginia Sneezeweed	*Helenium virginicum*	T	No	Seasonally flooded ponds and wetlands in southern Missouri.
Western Prairie Fringed Orchid	*Platanthera praeclara*	T	No	Prairies and meadows with measured periodic disturbance and consistent soil moisture throughout Missouri.

[a] E = Endangered, T = Threatened

Source: (USFWS 2015a)

Decurrent False Aster. The decurrent false aster is a perennial plant that grows 59-79 inches in height and is characterized by conspicuous decurrent leaves 2-6 inches long (USFWS, 1988a). This species was listed as threatened in 1988 (53 FR 45851 45861, November 14, 1988). Decurrent false aster is found on moist, sandy soils of prairie wetlands along river floodplains and is reliant on periodic flooding (USFWS, 1997c). This plant was historically found from Le Salle, IL, on the Illinois River downstream to St. Louis, MO, on the Mississippi River (USFWS, 1988a). In Missouri, this species is believed or known to occur in nine counties in the eastern and southern regions of the state (USFWS, 2015ap).

Current threats to this species include siltation, loss of habitat, and herbicides (USFWS, 1997c). All of these threats are linked to land development and agriculture, the first due to poorly managed soils and the second due to conversion of wet prairies and the construction of levees. Several populations have been discovered in areas of low-intensity agriculture, as the decurrent false aster thrives with occasional disturbance (USFWS, 1997c).

Earth Fruit (Geocarpon). Earth Fruit is a small annual species that is only easily visible for a few weeks during spring (USFWS, 2015aq). This species has opposite leaves and branches that measure approximately 0.4 to 1.5 inches long (USFWS, 1993a). Earth fruit (*Geocarpon minimum*) was listed as threatened in 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 Missouri, this species is known or believed to occur in eight counties in the southwestern region of the state (USFWS, 2015aq).

Throughout most its range, this species is found in areas with sparse vegetation and soils that have high concentrations of magnesium and sodium, with the exception of Missouri. In Missouri this species is only found in sandstone glades or outcrops of upland prairies (USFWS, 1993a). 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).

Eastern Prairie Fringed Orchid. The eastern prairie orchid, also known as the eastern prairie orchid, grows between 8 to 40 inches in height with a stalk of up to 40, white flowers, each with three fringed lips and a nectar tube (USFWS, 2015ar). The species was federally listed as threatened in 1989 (54 FR 39857 39863, September 28, 1989). Regionally, this species is believed or known to occur in Illinois, Indiana, Iowa, Maine, Michigan, Missouri, Ohio, Oklahoma, Virginia, and Wisconsin. In Missouri, the eastern prairie orchid is believe or known to occur in Carter, Grundy, and Ralls counties (USFWS, 2015ar).

The prairie orchid grows in a variety of habitats, from wetlands to prairies and requires full sun. Seedlings require soil fungi (called mycorrhizae) to establish themselves and develop more complete root systems (USFWS, 1999). Seed capsules mature over the growing season and are dispersed by the wind from late August through September. Plants may only flower once every few years (USFWS, 1999). Threats to the eastern prairie orchid include altered hydrology, invasive plant species, succession to woody vegetation, foot traffic, and collection (USFWS, 2012f).

Mead's Milkweed. Mead’s milkweed is a tallgrass herb characterized by a single stem which grows up to 16 inches tall. This plant has hairless leaves, a white wax coating, and a singular cluster of greenish-white flowers at the top (USFWS, 2005b). Mead’s milkweed was listed as threatened in 1988 (53 FR 33992 33996, September 1, 1988). Regionally, the species’ range extends from eastern Kansas to southern Illinois to southern Wisconsin. In Missouri, Mead’s milkweed is believed or known to occur in nineteen counties throughout the state (USFWS, 2015as).

Habitat for the species consists of “moderately wet to moderately dry upland tallgrass prairie or glade/barren habitat characterized by vegetation adapted for drought and fire”, which include stable prairie habitats (USFWS, 2005b). Threats to the species include habitat loss from farming and commercial development, habitat fragmentation, and hay mowing, which occurs in agricultural areas and can eliminate the early stages of the species' lifecycle (USFWS, 2005b)(USFWS 2005b).

Missouri Bladderpod. The Missouri bladderpod in an annual species that grows between 4 and 8 inches tall (USFWS, 1988b). 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 (USFWS, 1988b). 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 Missouri, the Missouri bladderpod is believed or known to occur in four counties in the southwestern region of the state (USFWS, 2015at). This species is typically found in shallow soils of limestone glades (USFWS, 2003c). Major threats to this species include habitat loss and degradation due to development, as well as competition with non-native plants (USFWS, 2003c).

Pondberry. The pondberry is a deciduous shrub, growing from less than 1 foot to more than 6 feet in height. "Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins" (USFWS, 2015au). 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, 2015au). 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 Missouri, the species is known or believed to occur in two counties in the southeastern region of the state (USFWS, 2015au). 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 (USFWS, 2015av). This species produces runners which extend horizontally from the base of stems and can produce roots at every node (USFWS, 2015av). 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 Missouri, the running buffalo clover is known or believed to occur in 29 counties throughout the state (USFWS, 2015aw). 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, 2011c). Human disturbance that impacts this species includes development, removal of wildlife, and the introduction of non-native species.

Virginia Sneezeweed. The Virginia sneezeweed is an herbaceous plant that grows to a height of 3.5 feet and exhibits winged stems and yellow flowers (USFWS, 2015ax) (VDCR, 2015). The Virginia sneezeweed was listed as threatened in 1998 (63 FR 59239 59244, November 11, 1998).

This species is found along the western edge of the Blue Ridge Mountains in the Shenandoah Valley in Virginia and in southern Missouri (USFWS, 2015ax) (VDCR, 2015). Suitable habitat for the Virginia sneezeweed includes seasonally flooded ponds and wetlands (USFWS, 2000). The primary threats to this species are habitat loss and degradation caused by urban development, timber operations, and road construction (USFWS, 2000).

Western Prairie Fringed Orchid. The Western prairie fringed orchid grows stalks up to four feet tall and each flowering stalk can have up to 24 white flowers (USFWS, 2015ay). The species was federally listed as threatened in 1989 (54 FR 39857 39863, September 28, 1989). Regionally, this orchid is believed or known to occur in Iowa, Kansas, Minnesota, Missouri, North Dakota, South Dakota, and Oklahoma. In Missouri, the western prairie fringed orchid occurs in 11 counties throughout the state (USFWS, 2015ay).

The western prairie fringed orchid is typically found in prairies and meadows with measured periodic disturbance (e.g., fire, mowing, or grazing) and consistent soil moisture (USFWS, 2015ay). This species has occasionally been observed in borrow pits and roadside ditches (USFWS, 1996c). Threats to the species include land conversion, impacts to the few species of sphinx moths which pollinate the orchid, and lowering of groundwater levels (USFWS, 1996c).

10.1.7. Land Use, Recreation, and Airspace

10.1.7.1. *Definition of the Resource*

The following summarizes major land uses, recreational venues, and airspace considerations in Missouri, 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" (Di Gregorio & Jansen, 1998). 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 man-made development (USGS, 2012b).

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. Recreational resources are typically managed by federal, state, county, or local governments.

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 for Missouri, highlighting areas of recreational significance within 6 identified regions in the state (MDNR, 2016a).

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 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 (ATO) 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, 2014). The ATO is comprised of Service Units (organizations) that support the operational requirements.

The FAA Air Traffic Services Unit (the 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). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

10.1.7.2. *Specific Regulatory Considerations*

Appendix C, Environmental Laws and Regulations, summarizes numerous federal environmental laws and regulations that, to one degree or another, may affect land use in Missouri. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities. MRS Chapter 89 outlines the framework for comprehensive development plans and land use plans for municipalities in Missouri (Missouri Legislature, 2015a).

Because the Nation's airspace is governed by federal laws, there are no specific Missouri state laws that would alter the existing conditions relating to airspace for this PEIS. State law pertaining to aircraft and airports is established in MRS Chapter 305. Section 305.575 provides information on structures (Missouri Government, 2015a).

10.1.7.3. *Land Use and Ownership*

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

Table 10.1.7-1 identifies the major land uses by coverage type in Missouri. Agriculture accounts for the largest portion of land use with 51 percent of Missouri's total land occupied by this category (Table 10.1.7-1 and Figure 10.1.7-1). Forest and woodland is the second largest area of land use with 38 percent of the total land area. Developed areas account for approximately six percent of the total land area. The remaining percentage of land include public land, surface water, and other land covers, shown in Figure 10.1.7-1, are not associated with specific land uses (USGS, 2011a).

Table 10.1.7-1: Major Land Use in Missouri by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	26,183	38.1%
Agricultural Land	35,527	51.7%
Developed Land	4,437	6.5%

Source: (USGS, 2011a)

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. The largest concentration of forest and woodland is within the Missouri Ozarks region in southern and central Missouri. Most forest and woodland areas throughout Missouri are privately owned (approximately 85 percent) (MDC, 2016j). Public land with forest and woodlands is found throughout the state. Most of the public landholdings are south of the Missouri River. The Mark Twain National Forest is comprised of several parcels in southern Missouri (Figure 10.1.7-1). Section 10.1.6 presents additional information about terrestrial vegetation.

State Forests

There are no State Forests in Missouri. Two different state agencies the Missouri Department of Conservation (MDC) and the Missouri Department of Natural Resources (MDNR) manage forest and woodland areas. The MDC manages Conservation Areas throughout the state, some of which include forest and woodland areas. The mission of the MDC is “To protect and manage fish, forest, and wildlife resources of the state and enhance their values for future generations…and to provide opportunity for all citizens to use, enjoy, and learn about fish, forest, and wildlife resources” (MDC, 2010b). The MDNR manages state parks throughout Missouri some of which include forest and woodland areas. The mission statement for the

MDNR State Park System is "...to protect our air, land and water; preserve our unique natural and historic places; and provide recreational and learning opportunities for everyone" (MDNR, 2016b).

Private Forest and Woodland

In 2006, nearly 339,000 private landowners collectively owned approximately 83 percent of Missouri's total forest and woodland areas, compared with today's 85 percent. About 75 percent of these private landowners held parcels less than 50 acres. Approximately 38 percent of the landowners had a farm associated with the forest and woodland area. Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities (USFS, 2011). For additional information regarding forest and woodland areas, see section 10.1.6, Biological Resources and Section 10.1.8, Visual Resources.

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in the northern, western, and southeastern regions of Missouri (Figure 10.1.7-1). Fifty percent of Missouri's total land area is classified as agricultural land (35,527 square miles). About 54 percent of Missouri has experienced extensive land use change due to cropland and pastureland creation (NRCS, 2010). In 2012, there were 99,171 farms in Missouri averaging 285 acres in size. Eighty-nine percent were owned and operated by families or individuals (USDA, 2014b). Some of the state's largest agricultural uses include soybeans, corn, hay, wheat, rice, and cotton. Other agricultural uses include poultry and eggs, cattle and calves, hogs and pigs, and turkeys (USDA, 2014b). Visit the USDA Census of Agriculture website: http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_1_State_Level/Missouri/st29_1_001_001.pdf for more information by county.

Developed Land

Developed land in Missouri tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 10.1.7-1). Approximately 6.4 percent of Missouri land is developed (USGS, 2011a). Table 10.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 10.1.7-1 shows where these areas are located within the developed land use category.

Table 10.1.7-2: Top Five Developed Metropolitan Areas in Missouri (2014 estimate)

Metropolitan Area	Population Estimate
St. Louis (MO/IL)	1,777,811
Kansas City (MO/KS)	855,909
Springfield	273,724
Columbia	124,748
Lee's Summit	85,081
Total Estimated Population of Metropolitan Areas*	3,117,273
Total State Estimated Population	6,063,589

*Because St. Louis and Kansas City metropolitan areas encompass portions of states outside of Missouri, the total population includes residents of other states (Illinois and Kansas).

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

Land Ownership

Land ownership within Missouri has been classified into four main categories: private, federal, state, and tribal.

Private Land

The majority of land in Missouri is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (U.S. Census Bureau 2015) (U.S. Census Bureau, 2016a) (Figure 10.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.[106]

Federal Land

The federal government manages 3,154 square miles (4.6 percent) of Missouri land with a variety of land types and uses, including military bases, national wildlife refuges, national forest, national monument, and national historic sites (Table 10.1.7-3) (USGS, 2012c) (USGS, 2014h). Four federal agencies manage federal lands throughout the state (Table 10.1.7-3 and Figure 10.1.7-2).[107] There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

[106] Total acreage of private land could not be obtained for the state.

[107] 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 data set 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.

Table 10.1.7-3: Federal Land in Missouri[108]

Agency	Square Miles	Representative Type
Department of Defense (including U.S. Army Corps of Engineers)	587	Military Bases, Facilities, Forts, Ranges, Recreation Areas
U.S. Fish and Wildlife Service	129	National Wildlife Refuges
USDA Forest Service	2,337	National Forest
National Park Service [a]	101	Monument, Historic Sites, Memorial, Battlefield,

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

Sources: (USGS, 2012c) (USGS, 2014h)

- The Department of Defense, including U.S. Army Corps of Engineers (USACE), owns and manages 587 square miles used for military bases, military facilities, forts, and ranges (USGS, 2012c) (USGS, 2014h);
- The U.S. Fish and Wildlife Service owns and manages 133 square miles consisting of nine National Wildlife Refuges in Missouri (USFWS, 2014d) (USFWS, 2015az);
- The USDA Forest Service owns and manages 2,337 square miles set aside as the Mark Twain National Forest (USFS, 2007); and
- The National Park Service manages 101 square miles consisting of National Monuments, National Historic Sites, National Memorials, National Scenic Riverways, and National Battlefields (NPS, 2014b) (USGS, 2012c) (USGS, 2014h).

State Land[109]

The Missouri state government owns approximately 1,469 square miles of land comprised of forests and woodlands, historic sites, state offices, and recreation areas. Two main state agencies, the Department of Conservation and the Department of Natural Resources, manage the majority of state lands. These two agencies manage land set aside as state parks, historic sites, natural areas, conservation areas, and wildlife management areas Table 10.1.7-3. (MDC, 2015p) (MDNR, 2015n)

Tribal Land

No land in Missouri is held in trust by the federal or state government on behalf of an American Indian tribe or tribes as permanent tribal homelands. Missouri does not have any federally recognized tribes currently located in the state, and the Bureau of Indian Affairs does not manage any land in the state (BLM, 2003).[110]

[108] Table identifies land wholly managed by the Agency; additional properties may be managed by or affiliated with the Agency; additional trails and corridors pass through Missouri that are part of the National Park System.

[109] 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.

[110] Although the Bureau of Indian Affairs "manages" Native American lands, the Bureau of Indian Affairs is different than other land management agencies as the lands are held in trust and are sovereign nations.

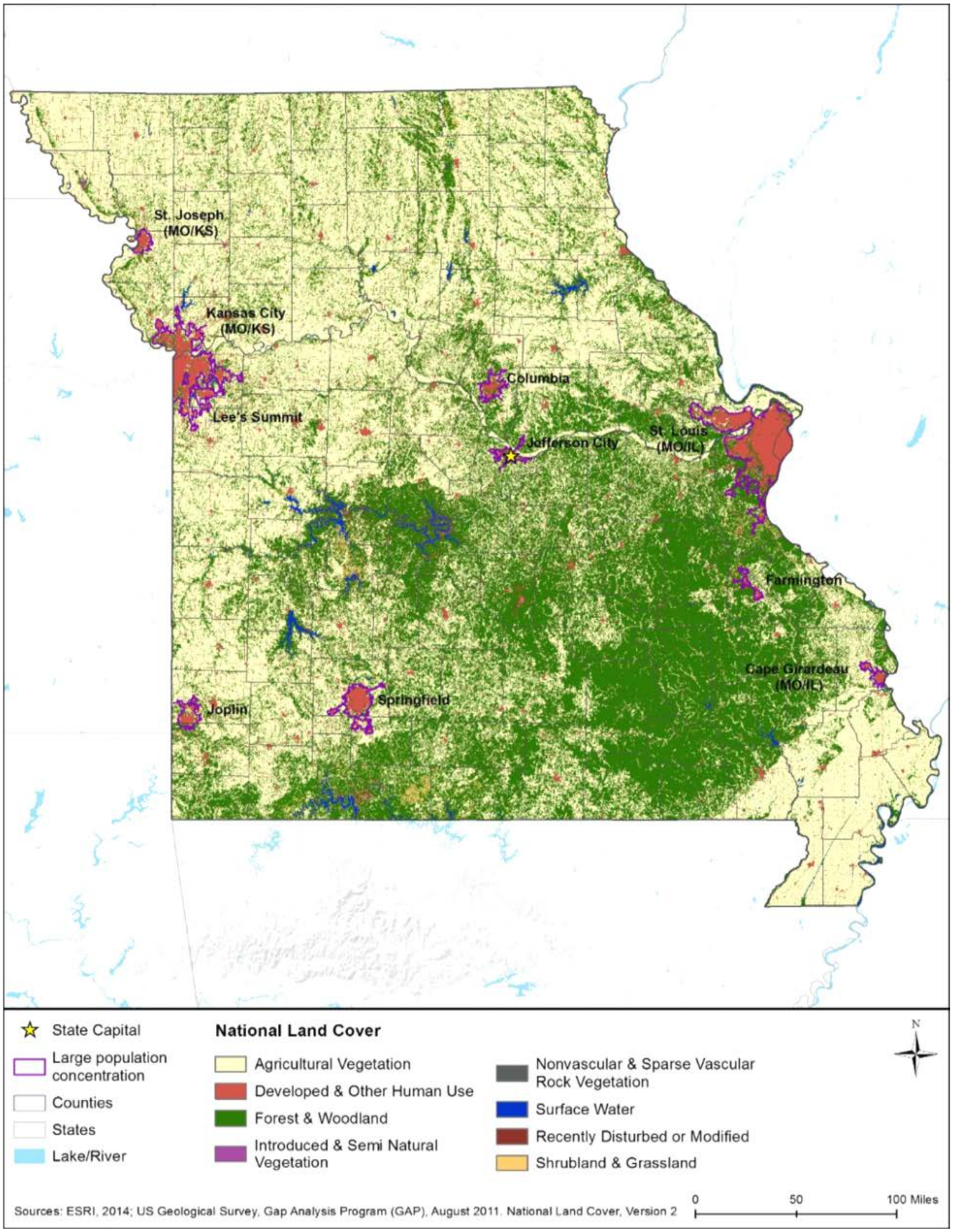

Figure 10.1.7-1: Land Use Distribution by Coverage Type

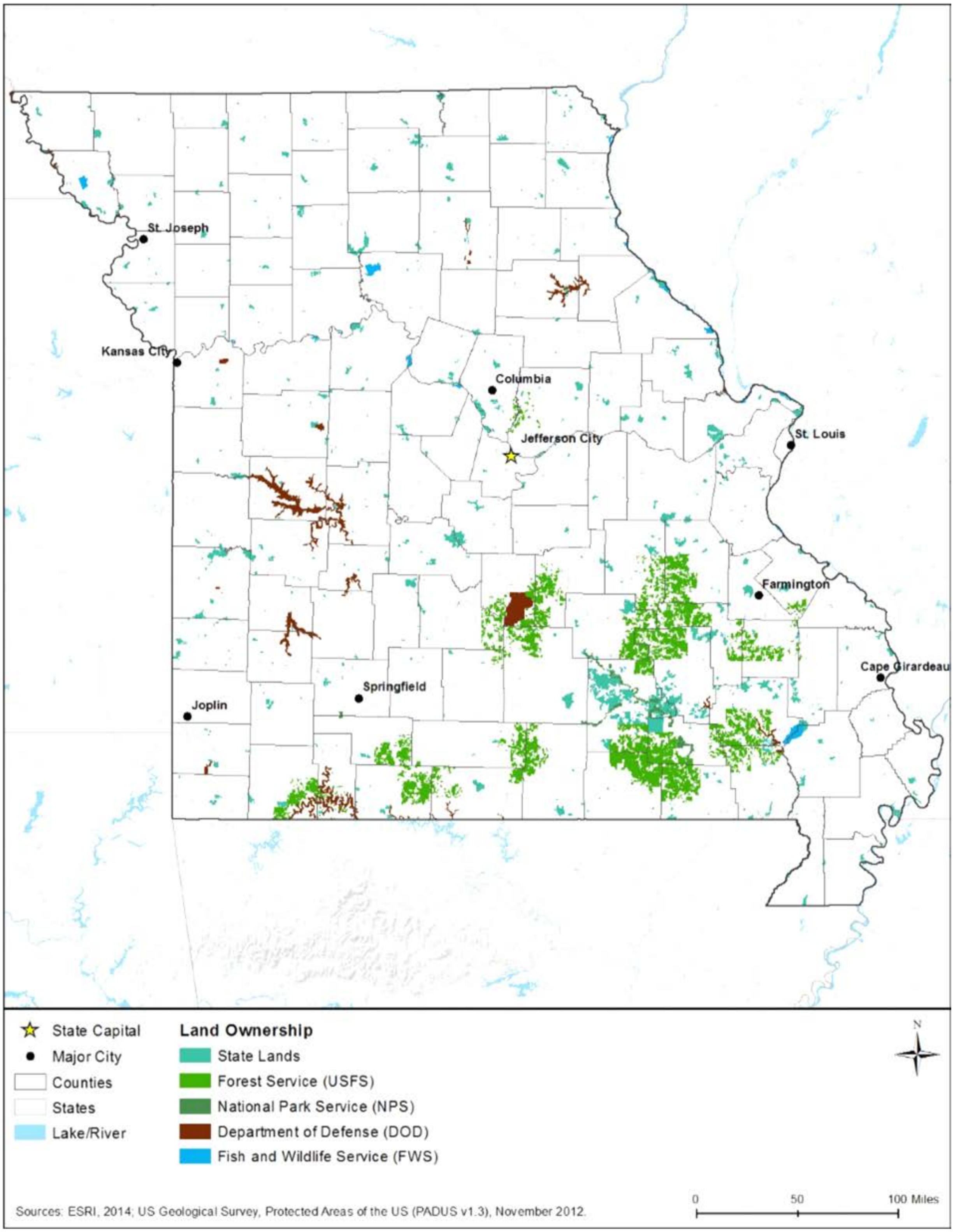

Figure 10.1.7-2: Land Ownership Distribution

10.1.7.4. *Recreation*

Missouri is located to the west of the Mississippi, and contains highly varied geography: rivers including the Mississippi and Missouri and the Ozark Mountains are important for the state's recreational aspects. The state's two most visited cities are St. Louis on the Mississippi River on the east, and Kansas City at the junction of the Missouri and Kansas Rivers on the western border. Missouri is known for its national trails: many trails either originate or pass through the state in its entirety, including the California, Lewis and Clark, Oregon, Pony Express, Santa Fe, and Trail of Tears National Historic Trails (NPS, 2015c). 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, and lake or river access points. Availability of community-level facilities is typically commensurate to the population's needs.[111]

This section discusses recreational opportunities available at various locations throughout Missouri. For information on visual resources, see Section 10.1.8, Visual Resources, and for information on the historical significance of locations, see Section 10.1.11, Cultural Resources.

Kansas City Region

Missouri's Kansas City Region consists of the northwestern portion of the state, and the Missouri River cuts through the center of the region before becoming the state's western boundary with Kansas and Nebraska. To the north, the region is bordered by Iowa (see Figure 10.1.7-1).

The Rock Island Trail State Park is a path from Windsor to Pleasant Hill, MO; the multi-use trail has hiking, bicycling, and is near to wildlife viewing and other recreational opportunities (Missouri State Parks, 2016b). The National Frontier Trails Museum has exhibits focusing in the Lewis and Clark Expedition and pioneers that used various trails either beginning or passing through Missouri to travel westward (City of Independence, 2016).

Kansas City is the largest city in the state of Missouri. Riverboat casinos are located on the Missouri River, and the Kansas Speedway is visited by approximately 73,000 people per race weekend (Visit KC, 2016). Kansas City is home to museums, zoos, and historical sites, including the Thomas Hart Benton Home and Studio State Historic Site, a museum with interpretive programs (Missouri State Parks, 2016a).

Northeast Region

The Northeast Region is bordered on the north by Iowa and the east by the Mississippi River and Illinois (Figure 10.1.7-1). It is notable as the home of Mark Twain: the Mark Twain Birthplace State Historic Site is a museum with interpretive programs and fishing on Mark Twain Lake; the

[111] 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 data set 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.

Mark Twain State Park has hiking trails; fishing, swimming, and other water activities; and camping and picnicking (Missouri State Parks, 2016c) (Missouri State Parks, 2016d). Other state parks in the region are known for the rolling hills typical of the region, with fishing and camping popular activities. Crowder, Cuivre River, and Pershing State Parks have hiking, horseback riding, bicycling, and other trail use; fishing, swimming, and other water activities; camping, metal detecting, and picnicking. (Missouri State Parks, 2016e) (Missouri State Parks, 2016f) (Missouri State Parks, 2016g)

Central Region

Missouri's Central Region's defining feature is the Missouri River (see Figure 10.1.7-1). The Katy Trail State Park is the country's longest rails-to-trails path, a multi-use trail for hiking, bicycling, and horseback riding, which follows the Missouri River through the region east to the Mississippi River (Missouri State Parks, 2016h). Several historic sites lay along the Missouri River, including cemeteries with prominent Missourians and identified locations from the Lewis and Clark Expedition (Missouri State Parks, 2016i). Boone's Lick State Historic Site has the ruins of the salt business, generated from the salt springs, begun by Daniel Boone's sons (Missouri State Parks, 2016j).

Lakes Region

Missouri's Lakes Region, the southwestern corner of the state, consists mainly of the Ozark Mountains. It is bordered to the west by Kansas and Oklahoma and to the south by Arkansas (see Figure 10.1.7-1). State parks in the Lakes Region focus on water activities. The Lake of the Ozarks State Park has hiking, bicycling, horseback riding, cave tours, rock climbing, and other trail use; boating, fishing, swimming beaches, and other water activities; and camping, metal detecting, and picnicking (Missouri State Parks, 2016k). The Roaring River State Park has hiking and other trail use; fishing and a swimming pool; and camping and picnicking (Missouri State Parks, 2016l). Pomme de Terre State Park has hiking and other trail use; boating, fishing, swimming beaches and other water activities; camping, metal detecting, and picnicking (Missouri State Parks, 2016m). Branson, located on Lake Taneycomo within the Ozarks, sees nearly eight million tourists annually. It is known for live music, theater, and shows. Branson's Marvel Cave, inside an amusement park, and Talking Rocks Cavern, inside a nature preserve, have tours and are open for exploration (Bransonshows.com, 2016).

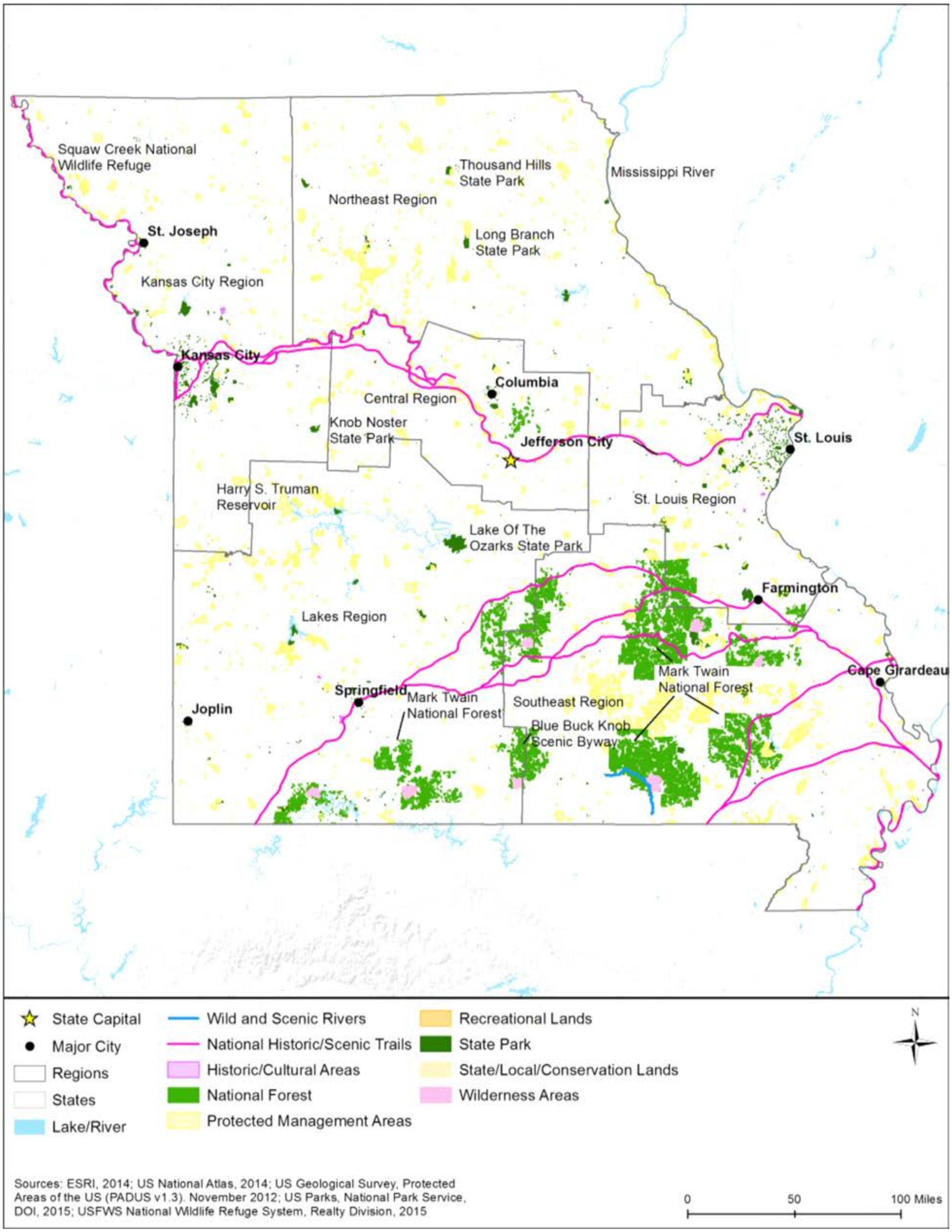

Figure 10.1.7-3: Missouri Recreation Resources

St. Louis Region

The St. Louis Region is bordered to the east by the Mississippi River, and is generally made up of the St. Louis metropolitan area, with the Missouri River cutting through the northern part of the region (see Figure 10.1.7-1). The Gateway Arch is the most famous attraction in the region, with a museum and tram rides to the top of the arch, providing a panoramic view of the city (NPS, 2016a). St. Louis is home to many museums, including the Griot Museum of Black History, the Mastodon State Historic Site, and the Delta Dental Health Theatre (St. Louis Convention and Visitors Commission, 2016). A variety of locations associated with significant historical events and people are located in the St. Louis Region: the Scott Joplin House State Historic Site provides tours of the ragtime musician's home (Missouri State Parks, 2016n); the Edward 'Ted' and Pat Jones Confluence Point State Park marks the beginning point of the Lewis and Clark Expedition (Missouri State Parks, 2016o); and the First Missouri State Capitol State Historic Site has interpretive programs illustrating life in the early 1800s when the state's government was founded (Missouri State Parks, 2016p).

Southeast Region

The Southeast Region is bordered to the south by Arkansas and the east by Illinois and Tennessee. The region is mainly within the Ozarks Mountains and foothills (Figure 10.1.7-1). The Mark Twain National Forest is primarily in Missouri's Southeast Region, which includes the Eleven Point National Scenic River, a 44-mile float river through the Ozark hills. The forest has sand play areas, swimming, boating, fishing, and other water activities; hiking, backpacking, bicycling, horseback riding, and other trail use; camping, rock hounding, and picnicking; and seasonal licensed big game, small game, and waterfowl hunting (USFS, 2016). The Ozark National Scenic Riverways is the first national park dedicated to protecting the Current and Jack Forks Rivers, known for floating, canoeing, swimming, boating, and fishing. Other activities within the park include hiking, horseback riding, bicycling, and other trail activities; camping, stargazing, and birdwatching; and seasonal, licensed hunting (NPS, 2015d). The Ozarks are also known for the cave systems, such as those Onondaga Cave State Park, with guided tours, hiking, bicycling, and other trail activities; camping and picnicking; and boating, swimming, and other water activities (NPS, 2016b).

10.1.7.5. *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 10.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[112] service is based on the airspace classification (FAA, 2008).

Figure 10.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[113]. 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).[114]

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

[113] 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)

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

- **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).

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 10.1.7-4).

Table 10.1.7-4: 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."

SUA Type	Definition
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 109.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual (AIM) 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 10.1.7-5, 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 10.1.7-5: 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 (FSS) located on an airport, but no operational control tower. The FSS 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 the state of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft 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)

Aerial System Considerations

Unmanned Aerial Systems

Unmanned Aerial 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).

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 (SAA) 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 SAA 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 or their property.

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 ft aboveground level
  - Any construction or alteration:
  - within 20,000 ft 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 ft
  - within 10,000 ft 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 ft
  - within 5,000 ft 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.

Missouri Airspace

The Aviation Team resides in the Multimodal Operations Division of the MoDOT. The Aviation Team is responsible for airport maintenance via the administration of federal and state funds, airport safety, and maintenance of the states' airport system plan (MoDOT, 2013d). There are two FAA FSDOs for Missouri located in Kansas City and St. Louis (FAA, 2015b).

Missouri 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 (MoDOT, 2013e). Figure 10.1.7-5 presents the different aviation airports/facilities residing in Missouri, while Figure 10.1.7-6 and Figure 10.1.7-7 present the breakout by public and private airports/facilities. There are approximately 490 airports within Missouri as presented in Table 10.1.7-6 (USDOT, 2015).

Table 10.1.7-6: Type and Number of Missouri Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	124	241
Heliport	1	118
Seaplane	3	0
Ultralight	0	3
Balloonport	0	0
Gliderport	0	0
Total	128	362

Source: (USDOT, 2015)

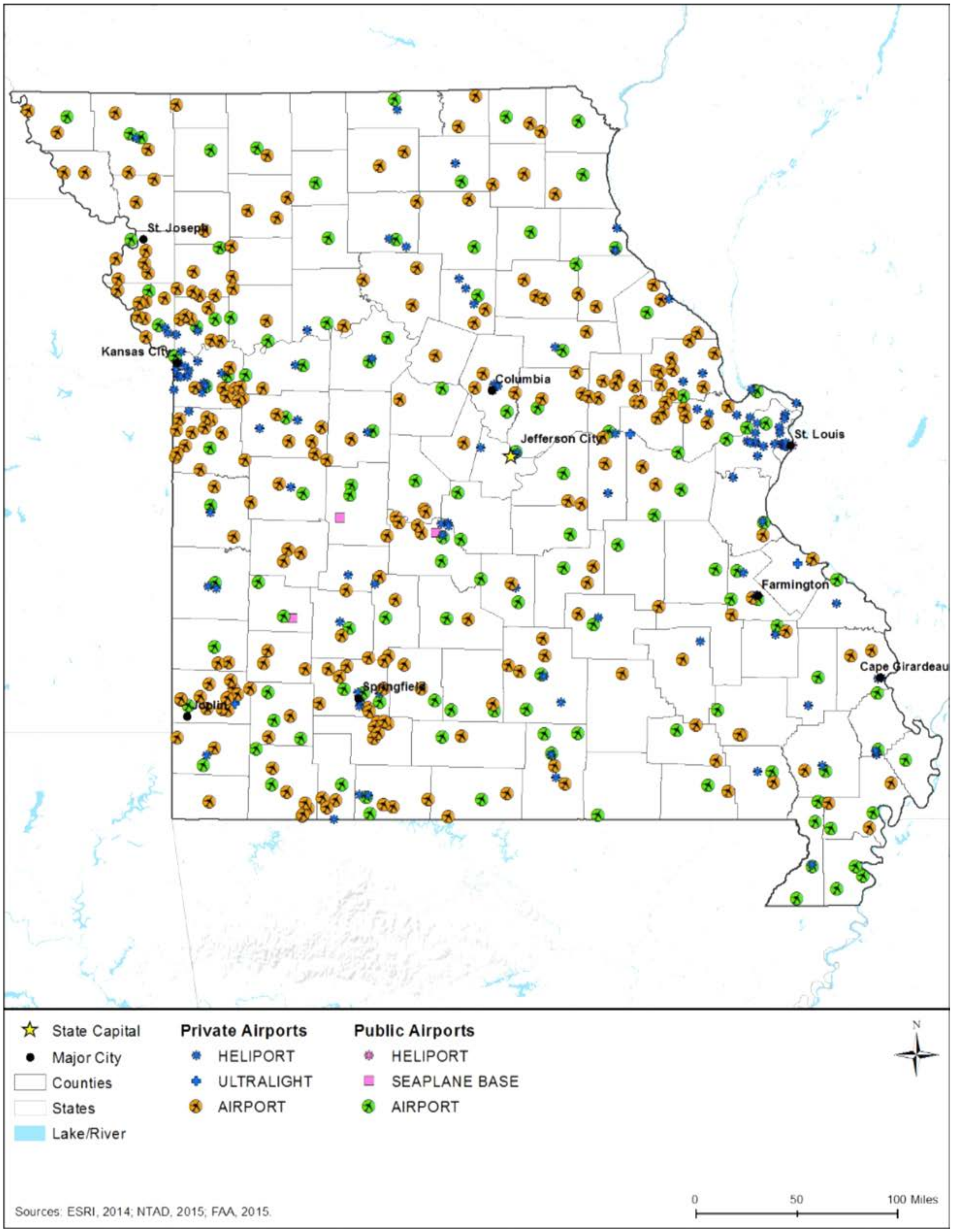

Figure 10.1.7-5: Composite of Missouri Airports/Facilities

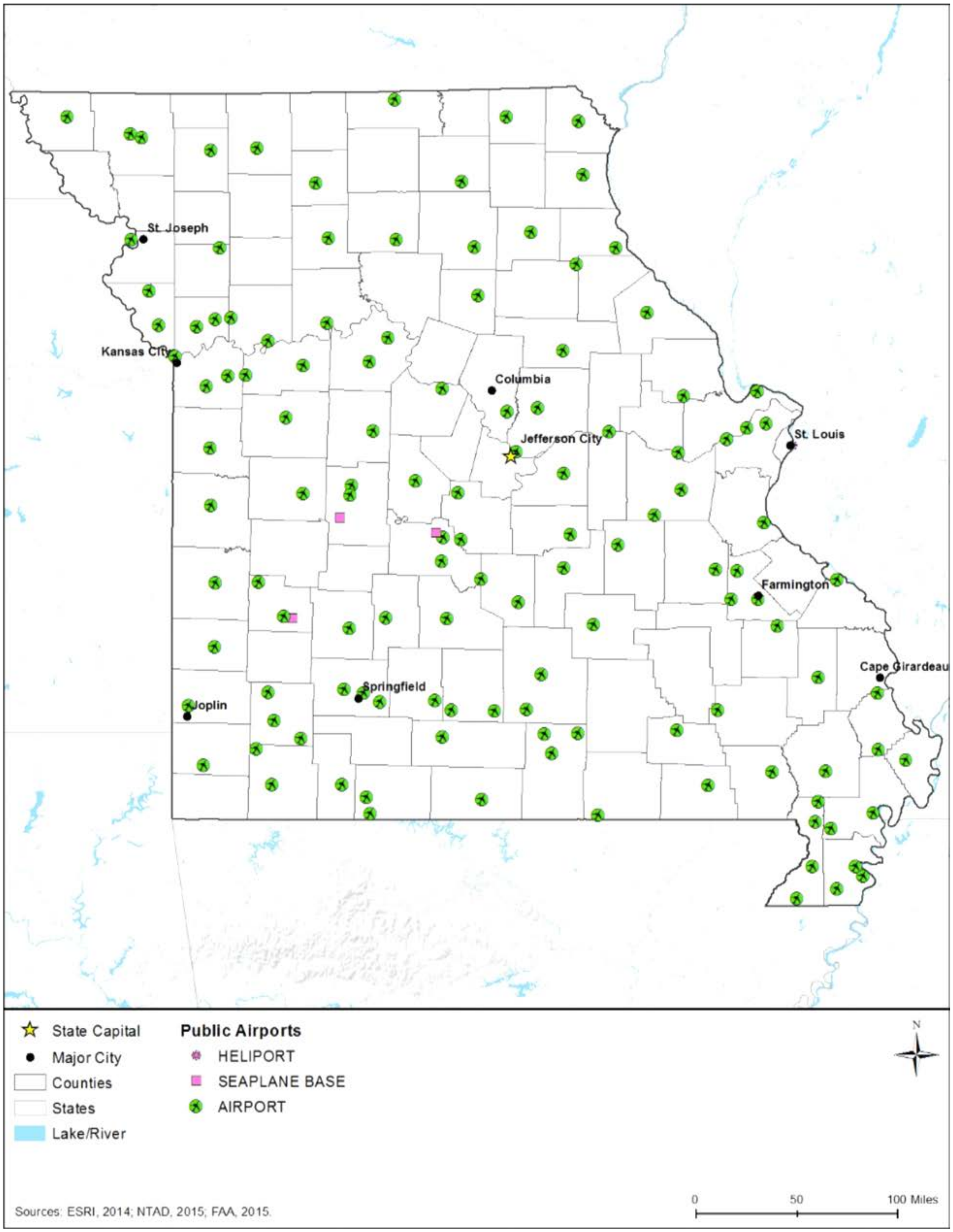

Figure 10.1.7-6: Public Missouri Airports/Facilities

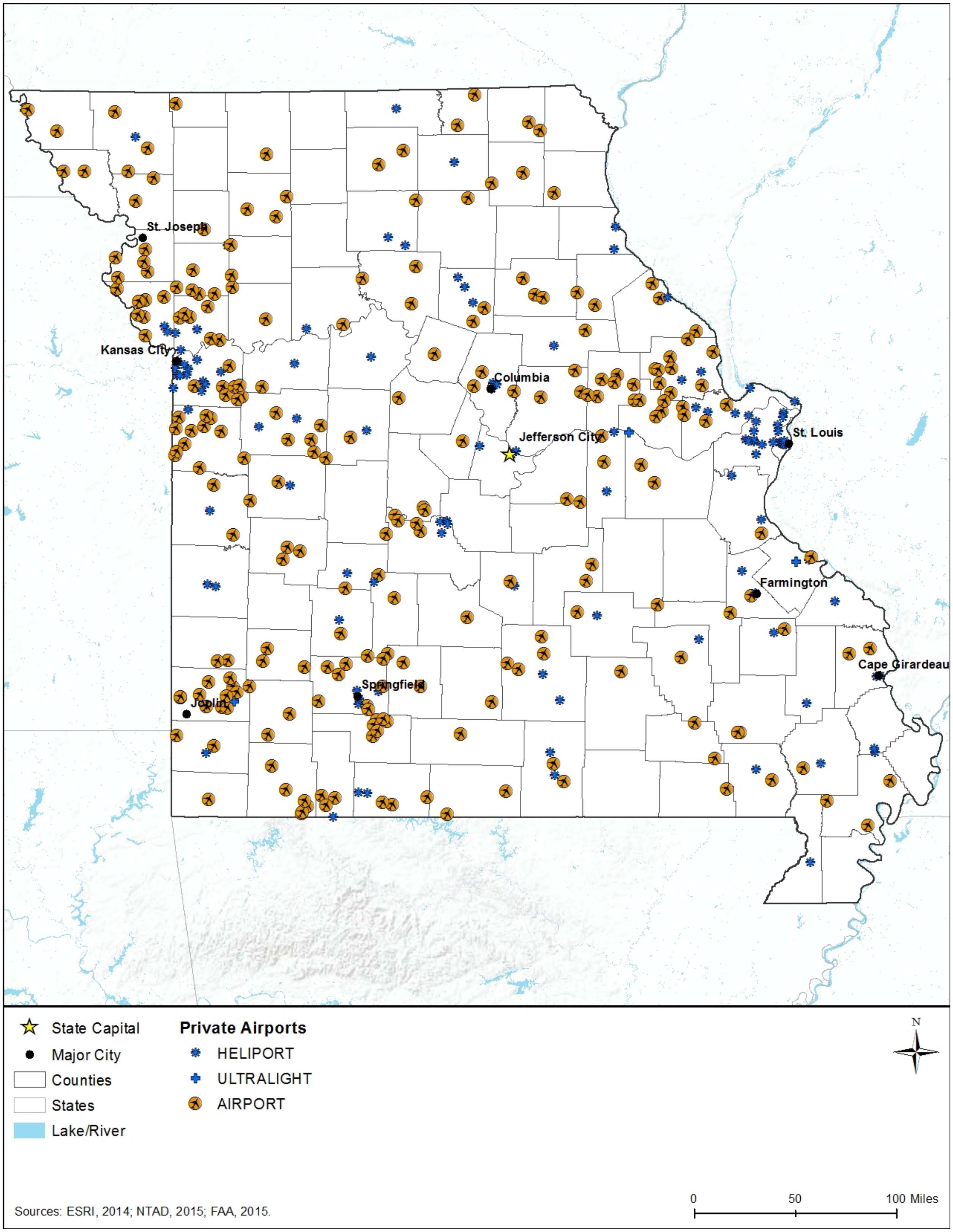

Figure 10.1.7-7: Private Missouri Airports/Facilities

There are Class B, Class C, and Class D controlled airports in Missouri as follows:

- Two Class B –
  - Kansas City International
  - Lambert-St. Louis International
  - Note – Cincinnati/Northern Kentucky International Airport, Covington, KY extends into Missouri
- One Class C –
  - Springfield-Branson National
- Ten Class D –
  - Branson
  - Cape Girardeau Municipal
  - Columbia Regional
  - Waynesville Regional Airport at Forney Field
  - Jefferson City Memorial
  - Joplin Regional
  - Kansas City Charles B. Wheeler Downtown
  - Whiteman Air Force Base, Knob Noster
  - St. Joseph, Rosecrans
  - St. Louis, Spirit of St. Louis (FAA, 2015e)

SUAs (i.e., seven restricted areas and nine MOAs) located in Missouri are as follows:

- Fort Leonard Wood (Restricted)
  - R-4501A West – Surface to, but not including 2,200 feet MSL
  - R-4501B East – The area north of a line between lat. 37°42'51"N, long. 92°06'48"W; and lat. 37°42'53"N, long. 92°09'18"W, surface to 1,500 feet MSL. The area south of this line, surface to 2,200 feet MSL
  - R-4501C – From 2,220 feet MSL to 5,000 feet MSL
  - R-4501D – From 5,000 feet MSL to 12,000 feet MSL
  - R-4501E – From 12,000 feet MSL to FL 180
  - R-4501F – Surface to 3,200 feet MSL
  - R-4501H – Surface to 3,200 feet MSL (FAA, 2015f)

The nine MOAs for Missouri are as follows:

- Cannon –
  - A – 300 feet AGL up to, but not including, FL 180
  - B – 100 feet AGL to, but not including, FL 180
- Lindbergh –
  - A – 7,000 feet MSL to, but not including, FL 180
  - B – 8,000 feet MSL to, but not including, FL 180
  - C – 8,000 feet MSL to, but not including, FL 180
- Salem – Surface to, but not including, 7,000 feet MSL; Excluding that airspace 1,500 feet AGL and below within a 3 NM radius of the Viburnum Airport in Viburnum, Bismarck Airport in Bismarck, and Dove Airport in Middle Brook

- Truman –
  - A – 8,000 feet MSL to, but not including, FL 180
  - B – 8,000 feet MSL to, but not including, FL 180
  - C – 500 feet AGL to but not including FL 180; excluding the airspace below 1,500 feet AGL within a 3NM radius of the town of Warsaw, MO. (FAA, 2015f)

The SUAs for Missouri are presented in Figure 10.1.7-8. There are no TFRs (Figure 10.1.7-8) (FAA, 2015g). MTRs in Missouri, presented in Figure 10.1.7-9, consist of four Visual Routes, four Instrument Routes, and seven Slow Routes.

UAS Considerations

The National Park Service (NPS) signed a policy memorandum on June 19, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating on lands or waters administered by the National Park Service" (NPS, 2014c). There are six National Parks in Missouri that must comply with this agency directive (NPS, 2015c).

Obstructions to Airspace Considerations

Several references in the Missouri Revised Statutes address airspace hazards and zoning requirements pertaining to any structure or modification that can be considered an obstruction to aircraft and airport safety. As defined in the Missouri Code Section 305.575.1, an airport hazard "endangers the lives and property of users of the airport and of occupants of land in its vicinity and impairs the utility of the airport and the public investment therein" (Missouri Government, 2015b). A permit is required to erect any new structure or to change an existing structure pursuant to the provisions of Missouri Code Section 305.575.1 (Missouri Government, 2015b).

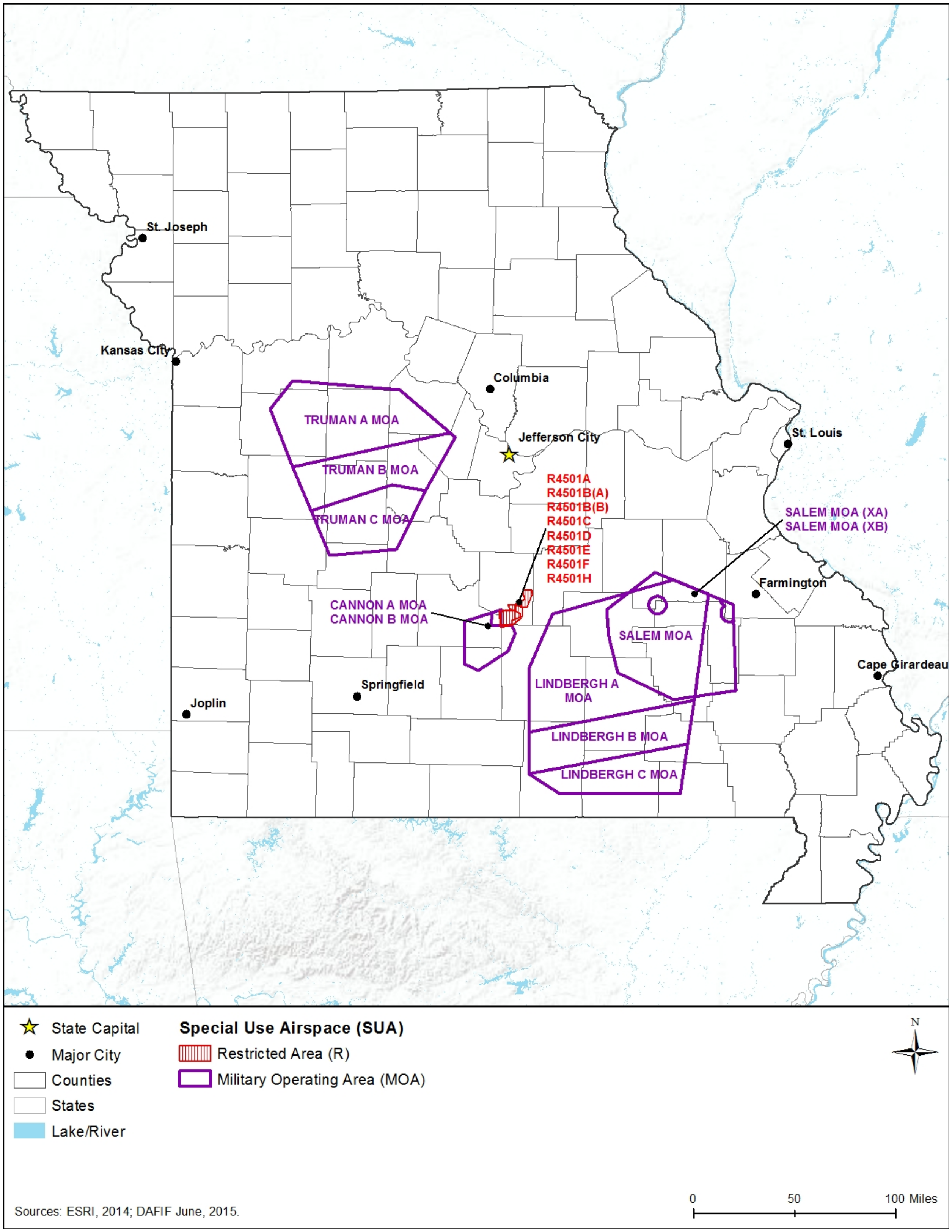

Figure 10.1.7-8: SUAs in Missouri

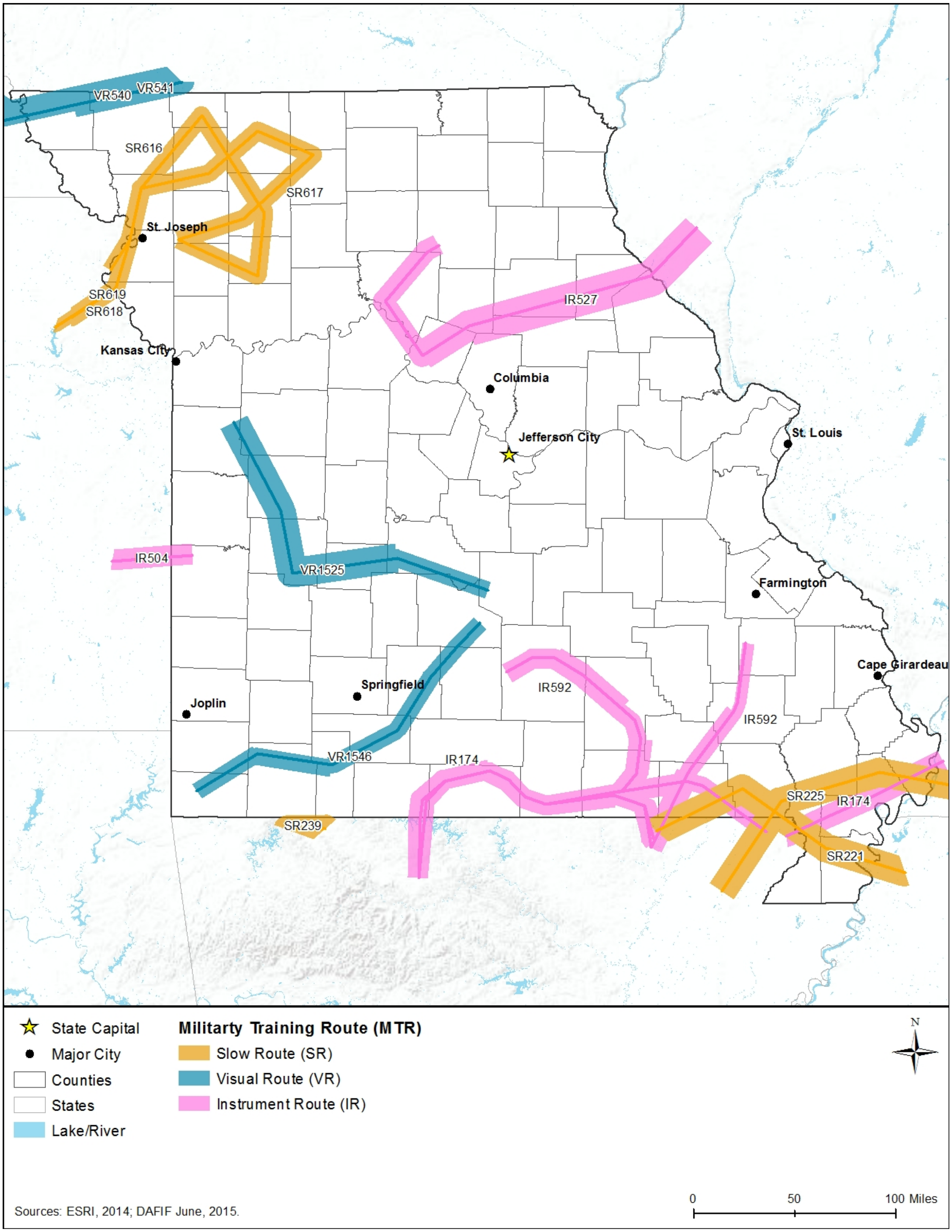

Figure 10.1.7-9: MTRs in Missouri

10.1.8. Visual Resources

10.1.8.1. *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 such as mountain ranges, city skylines, ocean views, unique geological formations, rivers, and constructed landmarks such as bridges, memorials, cultural resources, or statues are considered visual resources. For some, cityscapes are valued visual resources; for others, views of natural areas are valued visual resources. 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 National Historic Preservation Act (NHPA) compliance. The federal government does not have a 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, "the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)." (BLM, 1984)

10.1.8.2. *Specific Regulatory Considerations*

Table 10.1.8-1 presents state and local laws and regulations that relate to visual resources for Missouri.

Table 10.1.8-1: Relevant Visual Resources Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
MRS, Chapter 253.408-412	MDNR	Establishes the "State Historic Preservation Act" and designates the Director of the DNR as the State Historic Preservation Officer. Also establishes the State Historic Preservation Office within the DNR to establish, implement, and administer federal and state programs and plans for historic preservation.
MRS, Chapter 253.415.1	Local governments	Establishes the "Local Historic Preservation Act" and provides the authority for local governments to create historic preservations commissions empowered to carryout historical preservation responsibilities including surveying resources with "scenic significance to the locality, state or nation."
MRS, Chapter 253	MDNR	Gives authority for administration of state parks and National Historic Preservation Act to DNR.
MRS, Chapter 226.797.1-6	Missouri Highways and Transportation Commission	Establishes the state system of scenic byways to "create and preserve rustic, historic or scenic roads and highways for vehicular, bicycle and pedestrian travel in unhurried, quiet and leisurely enjoyment; to protect and preserve a part of Missouri's transportation history, historic roads and cultures, recreational driving, beauty, trees, vegetation and wildlife by establishing protective standards for scenic byway design, access, maintenance, preservation, and identification, which will promote a continuous system of scenic byways for the public health and welfare."
MRS, Chapter 226.380.1	MoDOT	Prohibits use of areas under "scenic" easement and restricts building on these areas specifically.

In addition to the state laws and regulations, in Missouri local jurisdictions have the authority to establish historic preservation programs to protect important historic visual resources within the state.

10.1.8.3. *Character and Visual Quality of the Existing Landscape*

Missouri's landscape varies from prairie and plain to low mountains. The state is mostly fertile prairie lands but includes mountains and two major U.S. Rivers, the Mississippi and Missouri. The southwestern portion of the state is comprised of the Ozark Plateau with low mountains and forested hills, caves, lakes and rivers, while the southeastern part of the state includes the St. Francois Mountain and the state's highest point (World Atlas, 2015). The largest manager of public lands in Missouri is the U.S. Forest Service with approximately 1.5M acres. Additionally, the USACE, U.S. Fish and Wildlife Service (USFWS), and NPS also maintain lands in the state (Natural Resources Council of Maine, 1995).

Croplands are the most prevalent visual resource within Missouri, comprising 51 percent of the total land cover. Forest and woodlands account for 38 percent of total land cover (Figure 10.1.7-1 in Section 10.1.7, Land Use, Recreation, and Air Space) (USGS, 2011a).

Cropland's visual resources consist of either row crops, closely sown crops or fallow land awaiting planting. Crops may include hay, silage, fruit trees, berries, tree nuts, vegetables, or melons (USDA, 2014c). Forested lands are the second most prevalent visual resource within the state (USDA, 2015). 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. One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur (USFS, 1995a). Section 10.1.7, Land Use, Recreation, and Airspace discusses land use and contains further descriptions of land cover within the state.

While the state and many municipalities have some regulations covering 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.

10.1.8.4. *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 10.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Missouri, there are 2,224 NRHP listed sites, which include 37 National Historic Landmarks, 1 National Heritage Area, 1 National Battlefield, 1 National Monument, 1 National Expansion Memorial, 6 National Historic Trails, and 2 National Historic Sites (NPS, 2015c). In addition, there are 16 NNLs. Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

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, 2016c). 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 Missouri, there are 37 NHLs, including Arrow Rock, Field House, Fort Osage, Tower Grove Park, and Laura Ingalls Wilder House (NPS, 2015f). By comparison, there are over 2,500 NHLs in the United States (NPS, 2015g). Figure 10.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Heritage Area

National Heritage Areas (NHAs) are "places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape" (NPS, 2011). These areas help tell the history of the United States. Based on this criteria, NHAs in Missouri may contain scenic or aesthetic areas considered visual resources or visually sensitive. There is one NHA in Missouri: Freedom's Frontier National Heritage Area (Figure 10.1.8-1). Freedom's Frontier NHA includes parts of eastern Kansas and Western Missouri. This NHA recounts the struggle between abolitionists in Kansas and pro-slavery advocates in Missouri and reflects the struggle for freedom among various groups – Women, American Indians, African Americans – in the "communities and landmarks" of the region (NPS, 2015h).

National Battlefield

Missouri has one (1) National Battlefield, which is preserved by the NPS to "commemorate persons, events, and activities important in the nation's history." (NPS, 2003a). Wilson's Creek National Battlefield is the location of the first "Civil War battle fought west of the Mississippi

River and the site of the" first Union general, Nathaniel Lyon, killed in action. This battlefield may contain aesthetic and scenic values associated with history (NPS, 2015c).

National Monument

NPS defines a national monument as a "nationally significant resource…smaller than a national park and [lacking]…diversity of attractions." Missouri is home to one national monument managed by the NPS: George Washington Carver National Monument (Table 10.1.8-2) (NPS, 2015c). George Washington Carver National Monument recognizes George Washington Carver's "quest for education to [become] a renowned agricultural scientist, educator and humanitarian" and includes visual resources such as woodlands, streams, tallgrass prairie, and historic homes (NPS, 2015i).

National Expansion Memorial

NPS defines national memorials as "areas that are primarily commemorative." (NPS, 2003a) Missouri is home to a National Expansion Memorial managed by NPS: Jefferson National Expansion Memorial (see Figure 10.1.8-1) (NPS, 2015c). Jefferson National Expansion Memorial in St. Louis includes the Gateway Arch monument and memorializes the role of Thomas Jefferson and the pioneers in the westward expansion of the U.S. (NPS, 2015g). Additionally, the Memorial includes the Old Courthouse where Dred Scott used for his freedom.[115] (NPS, 2015g)

National Historic Trails

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, 2012a). Six National Historic Trails pass through Missouri and surrounding states (see Figure 10.1.8-3): California National Historic Trail, Lewis & Clark National Historic Trail, Oregon National Historic Trail, Pony Express National Historic Trail, Santa Fe National Historic Trail, and Trail of Tears National Historic Trail. The California National Historic Trail follows the path of gold rush emigrants during the greatest migration in U.S. history along more than 1,000 miles across 10 states. The Pony Express National Historic Trail was the fastest and most direct east-west communication before the invention of the telegraph (NPS, 2015m).

[115] Held in St. Louis' Old Courthouse in 1857, the Dred Scott case was a landmark decision by the U.S. Supreme Court deciding that enslaved or free African Americans were not American citizens, were unable to sue in federal court, and that the federal government could not regulate slavery in areas acquired after the creation of the United States. An enslaved African American, Dred Scott, attempted to sue for his freedom as he was taken by his owners to free states and territories. The court denied Scott's request (NPS, 2016e).

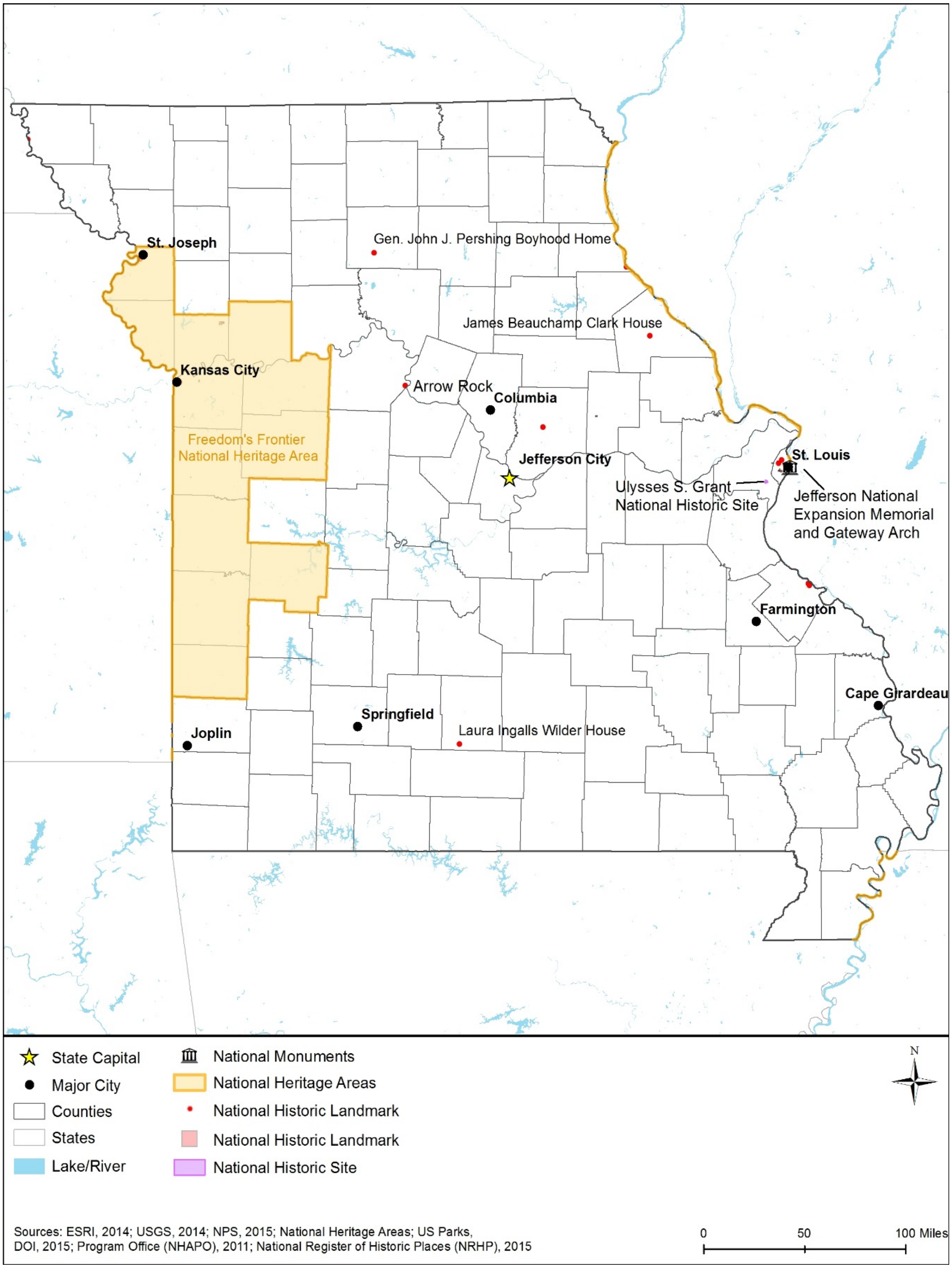

Figure 10.1.8-1: Representative Sample of Some Cultural and Heritage Resources that May be Visually Sensitive

National Historic Sites

Missouri has two National Historic Sites, which are preserved by the NPS to "commemorate persons, events, and activities important in the nation's history" (NPS, 2003a). The national historic sites in Missouri are Harry S. Truman and Ulysses S. Grant (NPS, 2015c). These sites may contain aesthetic and scenic values associated with history.

State Historic Sites and Parks

The Missouri Department of Natural Resources maintains 36 state historic sites and parks as part of the state's parks system (Missouri State Parks, 2015a). These sites include: Arrow Rock State Historic Site, Bollinger Mill State Historic Site, Confederate Memorial State Historic Site, Scott Joplin House State Historic Site, and Mark Twain Birthplace State Historic Site (Missouri State Parks, 2015a). These sites may contain aesthetic and scenic values associated with history.

10.1.8.5. *Parks and Recreation Areas*

Parks and recreation areas include State Parks, State Forests, National Parks, National Forests, National Monuments, 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 10.1.8-3 displays natural areas that may be visually sensitive, including park and recreation areas.[116]

[116] 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 data set 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.

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 Missouri, there are six[117] officially designated locations, in addition to other NPS affiliated areas, such as National Heritage Areas. There are 6 National Historic Trails, 1 National Monument, 2 National Historic Sites, 1 National Expansion Memorial, 1 National Scenic Riverways, and 1 National Battlefield (Figure 10.1.8-3) (NPS, 2015c) Table 10.1.8-2 identifies the National Parks and affiliated areas located in Missouri. For additional information regarding parks and recreation areas, see Section 10.1.7, Land Use, Recreation, and Airspace.

Figure 10.1.8-2: Ozark National Scenic Riverways

Source: (NPS, 2015l)

[117] Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

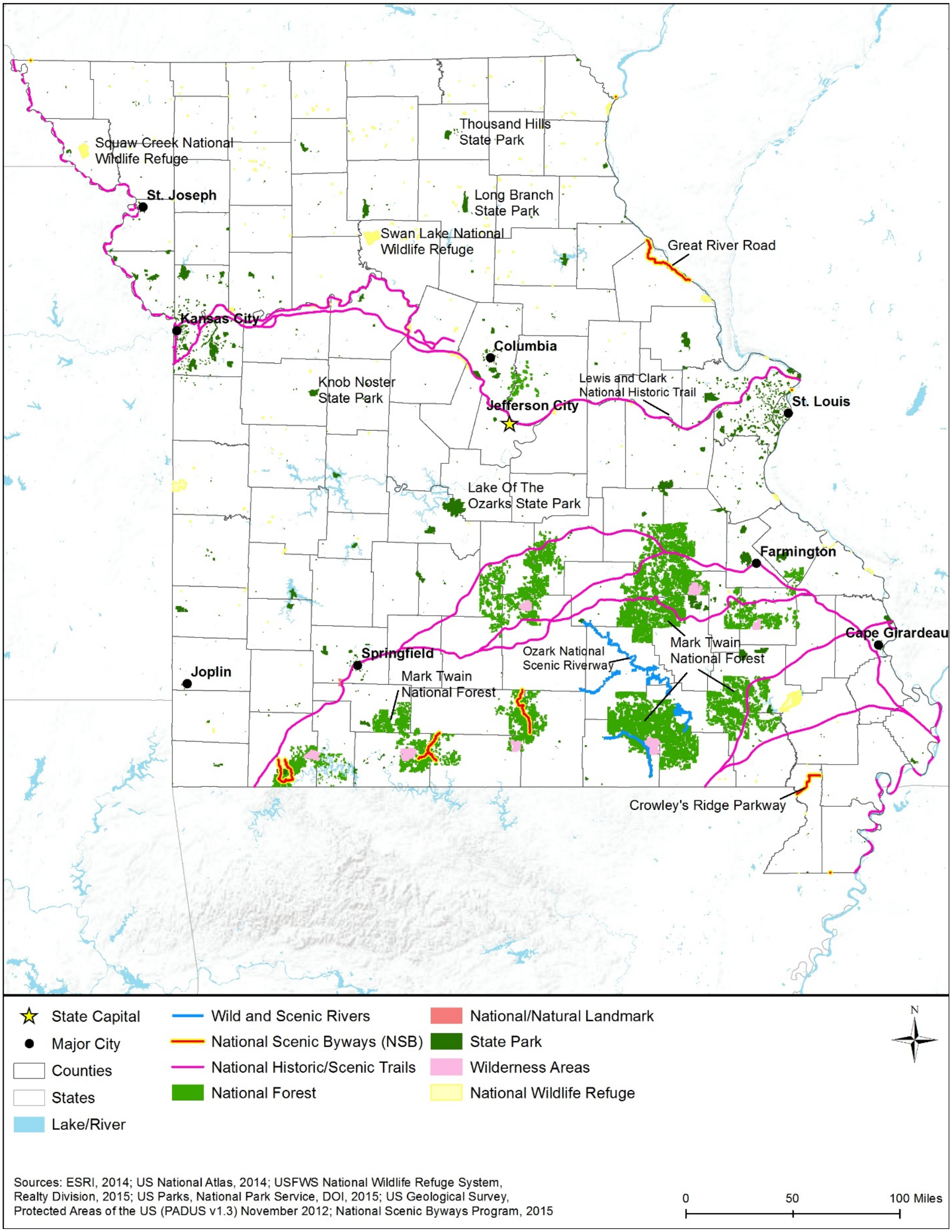

Figure 10.1.8-3: Natural Areas that May be Visually Sensitive

Table 10.1.8-2: Missouri National Parks and Affiliated Areas

Area Name	
California National Historic Trail	Ozark National Scenic Riverways
George Washington Carver National Monument	Pony Express National Historic Trail
Harry S. Truman National Historic Site	Santa Fe National Historic Trail
Jefferson National Expansion Memorial	Trail of Tears National Historic Trail
Lewis & Clark National Historic Trail	Ulysses S. Grant National Historic Site
Oregon National Historic Trail	Wilson's Creek National Battlefield

Source: (NPS, 2015c)

National Forests

There is one National Forest in Missouri managed by the U.S. Forest Service: Mark Twain National Forest (see Figure 10.1.8-3) (USFS, 2015b). Mark Twain National Forest consists of approximately 1.5M acres and is the largest amount of publically managed land in the state, accounting for 5 percent of the total land in Missouri (USFS, 2015c). The USFS conducts inventories of the forest lands and assigns scenic resource categories from which they manage for scenic and visual resources (USFS, 1995b). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995b).

U.S. Army Corps of Engineers Recreation Areas

There are 15 U.S. Army Corps of Engineers (USACE) recreation and flood risk management areas within the state (see Table 10.1.8-3) (USACE, 2015c). These lakes 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 10.1.8-3: U.S. Army Corps of Engineers Recreation Areas

Recreation Area Name	
Blue Springs Lake	Mississippi River – Pools 11 – 22
Bull Shoals Lake	Mississippi River – Upper
Clearwater Lake	Pomme de Terre Lake
Harry S. Truman Lake	Smithville Lake
Illinois River – Riverlands	Stockton Lake
Long Branch Lake	Table Rock Lake
Longview Lake	Wappapello Lake
Mark Twain Lake	

Source: (USACE, 2015c)

State and Federal Trails

The Missouri Department of Natural Resources maintains over 1,000 miles of recreation trails in state parks "to explore the state's natural beauty." These trails have aesthetic resources such as rolling prairie grass, densely wooded forests, Ozark Mountain peaks, wildlife, birds, streams, and rivers. For additional information about Missouri's trails, visit 'Hiking' on the Missouri State Parks' website. (Missouri State Parks, 2015b)

In addition to National Historic 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, 2015). In Missouri there are 20 National Recreation Trails administered by the U.S. Forest Service, U.S. Army Corps of Engineers, USFWS, local or state governments, and non-profit organizations (National Recreation Trails, 2015).

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Missouri residents and visitors. The Missouri Department of Natural Resources manages 52 state parks and recreation areas (Figure 10.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Missouri State Parks, 2015c). Table 10.1.8-4 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, visit the Missouri Department of Natural Resources' State Parks website (Missouri State Parks, 2015d).

Table 10.1.8-4: Examples of Missouri State Parks and Associated Visual Attributes

State Park	Visual Attributes
Big Oak Tree State Park	Flat flood plains, forested island, cypress swamp, hickory trees, oak trees, green ash trees, swamp cottonwood trees, American elm trees, black willow trees, persimmon trees, bald cypress trees, giant cane trees, swamp flora, wildlife, reptiles, amphibians, birds
Castlewood State Park	Meramec River, Lincoln Beach, palisade bluffs, white limestone bluffs, native bottomland forest, upland forest, white oak trees, northern red oak trees, shagbark hickory tees, wildlife
Lewis and Clark State Park	Native grasses, wildflowers, trees, Lewis and Clark Lake, waterfowl, cottonwood trees, sycamore trees
Prairie State Park	Tallgrass prairie, wildlife, bison, elk, native plants, birds
Wakonda State Park	Lakes, sand prairie, waterfowl, sandgrass, sand dropseed, prairie sunflower, swimming beach

Source: (Missouri State Parks, 2015e)

Figure 10.1.8-4: Wakonda State Park

Source: (Missouri State Parks, 2015f)

State Forests

The state of Missouri contains more than 14M acres of forested land, 85 percent of which is held by private property owners. Of the remaining 15 percent, 12 percent is managed by the U.S. Forest Service in the Mark Twain National Forest and 3 percent is owned and managed by the state and local governments (MDC, 2015q). Missouri manages the forests for multiple use purposes and "consideration for wildlife and aesthetic value are key when deciding when and what cuts need to be made" in management of state forests (MDC, 2015q).

10.1.8.6. *Natural Areas*

National Scenic Riverways

National Scenic Riverways are corridors designated by the National Park Service to "preserve ribbons of land bordering free-flowing streams which have not been dammed, channelized, or otherwise altered. Besides preserving rivers in their natural state, these areas provide opportunities for outdoor activities like hiking, canoeing, and hunting." (NPS, 2003b) Scenic riverways may be considered visual resources or visually sensitive. In Missouri there is one national scenic riverway, Ozark National Scenic Riverway (see Table 10.1.8-2). The Ozark National Scenic Riverway "is the first national park to protect [an entire] river system," including the Current and Jacks Fork Rivers (NPS, 2015n). Some of the natural features in this Riverway include clear rivers, freshwater springs, caves, and trails (NPS, 2015n).

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. 44.4 Miles of the Eleven Point River has been designated a National Wild and Scenic River in Missouri. The designated portion of the Eleven River is contained within the Mark Twain National Forest and, as such, is managed by the U.S. Forest Service.

(National Wild and Scenic Rivers System, 2015) Missouri does not designate separate state wild, scenic, or recreational rivers.

National Wildlife Refuges and State Wildlife Management Areas

National Wildlife Refuges (NWRs) are a network of lands and waters managed by the U.S. Fish and Wildlife Service (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, 2015ba). There are nine NWRs in Missouri (USFWS, 2015bd) (Table 10.1.8-5) including the Ozark Cavefish NWR. This refuge is comprised of 40 acres including Turnback Creek Cave Spring, which is the outlet for an underground cave where the threatened Ozark Cavefish live (USFWS, 2012g). Visual resources within this NWR include caves, a spring, and fish (USFWS, 2012g).

Table 10.1.8-5: Missouri National Wildlife Refuges

NWR Name	
Big Muddy NWR	Ozark Cavefish NW
Clarence Cannon NWR	Pilot Knob NW
Great River NWR	Squaw Creek NWR
Middle Mississippi NWR	Swan Lake NW
Mingo NWR	

Source: (USFWS, 2015bb)

The Missouri Department of Conservation "protects and manages the fish, forest, and wildlife resources of [Missouri]…to facilitate and provide opportunity for all citizens to use, enjoy, and learn about these resources" (MDC, 2015r). To this end, the state's wildlife strategy identifies 33 Conservation Opportunity Areas across four state regions to conserve wildlife and the environments in which they thrive (MDC, 2010a). Additionally, the Department of Conservation also recognizes 1,000 conservation and wildlife management areas for recreation, including hunting, trapping, and fishing (MDC, 2015s).

State Natural Areas

The Missouri Department of Conservation designates over 181 natural areas within the state for low-impact public recreation (MDC, 2015t) Visual resources in these areas include rare plants, animals, remnant prairies, old-growth forests, woodlands, wetlands and caves (MDNR, 2015o). The natural and conservation areas also include 16 properties owned and managed (often jointly) by the Department of Conservation, the Department of Natural Resources, the National Park Service, the Army Corps of Engineers, and The Nature Conservancy (The Nature Conservancy, 2015). These properties include the Current River, Thorny Mountain, Grand River Grasslands, Victoria Glade, and Marmaton River Bottoms Prairie Wetland (The Nature Conservancy, 2015). Thorny Mountain has one of the "most significant concentrations of biodiversity" in the mid-continental U.S. and is jointly managed by the Department of Conservation, National Park Service, and the Nature Conservancy (The Nature Conservancy, 2015).

National Natural Landmarks

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, 2014d). These landmarks may be considered visual resources or visually sensitive. In Missouri, there are 16 NNLs (see Table 10.1.8-6). Some of the natural features located within these areas include tall grass prairie remnants, karst topography, sinkholes, caves, springs, and bottomland and upland forests (NPS, 2012b).

Figure 10.1.8-5: Onondaga Cave

Source: (NPS, 2012c)

Table 10.1.8-6: Missouri National Natural Landmarks

NNL Name	
Big Oak Tree	Mark Twain and Cameron Caves
Carroll Cave	Marvel Cave
Cupola Pond	Onondaga Cave
Golden Prairie	Pickle Springs
Grand Gulf	Taberville Prairie
Greer Spring	Tucker Prairie
Maple Woods Natural Area	Tumbling Creek Cave
Maramec Spring	Wegener Woods

Source: (NPS, 2012b)

National Wilderness Areas

Congress enacted the Wilderness Act of 1964 to "establish a National Wilderness Preservation System for the permanent good of the whole people" to provide "clean air, water, and habitat critical for rare and endangered plants and animals" (U.S. Congress, 1964). The Wildnerness 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" (U.S. Congress, 1964). A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of the National Park System. Other designated wilderness areas are managed by the U.S. Forest Service, BLM, and USFWS (NPS, 2016d).

Missouri is home to eight federally managed Wilderness Areas (Table 10.1.8-7) (Wilderness.net, 2015).

Table 10.1.8-7: Missouri National Wilderness Areas

NWA Name	
Bell Mountain Wilderness	Mingo Wilderness
Devils Backbone Wilderness	Paddy Creek Wilderness
Hercules-Glades Wilderness	Piney Creek Wilderness
Irish Wilderness	Rockpile Mountain Wilderness

Source: (Wilderness.net, 2015).

10.1.8.7. *Additional Areas*

State and National 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. Missouri has two (2) designated National Scenic Byways: Crowley's Ridge Parkway and Great River Road, both of which are displayed on the map Figure 10.1.1-1 in Section 10.1.1. Crowley's Ridge Parkway is 212 miles of natural and historical sites along Crowley's Ridge. The Great River Road is 2,069 miles following the Mississippi River and passing through various locations of historic or cultural significance. (USDOT FHWA, 2015c)

Similar to National Scenic Byways, the Missouri Scenic Byways Program administers scenic byways with "exceptional examples of any of the following six intrinsic qualities: cultural, historical, archeological, natural, scenic and recreational" (MoDOT, 2013f). The Missouri Scenic Byways Program recognizes 11 scenic byways, which are noted in Table 10.1.8-8 (MoDOT, 2013c).

Table 10.1.8-8: Missouri State Scenic Byways

State Byway Name	
Bloomfield Stars and Stripes	Old Trails Road
Cliff Drive	Ozark Mountain Parkway
Cliff Drive Connection	Ozark Mountain High Road
Crowley's Ridge Parkway*	Show Me Santa Fe Trails
Little Dixie Highway of the Great River Road*	Spirit of Kansas City
Missouri Historic Route 66	

*Also a designated National Scenic Byway

Source: (MoDOT, 2013c)

10.1.9. Socioeconomics

10.1.9.1. *Definition of the Resource*

NEPA requires consideration of socioeconomics; 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)). Socioeconomics refers to a broad, social science-based approach to understanding a region's social and economic conditions. It typically includes estimated population, demographic descriptors, economic activity indicators, housing characteristics, property values, and public revenues and expenditures (BLM, 2005). When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet Proposed Actions as those Proposed Actions 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 Proposed 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. 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 12898. This PEIS addresses environmental justice in a separate section (Section 10.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: Land Use, Recreation, and Air Space (Section 10.1.7), Infrastructure (Section 10.1.1), and Visual Resources (Section 10.1.8).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. 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 U.S. Census Bureau's American Community Survey (ACS). The ACS is the U.S. 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, 2016c)[118]

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.

10.1.9.2. *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.

[118] 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 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. In many cases, the FirstNet PEIS report tables contain data from multiple Census Bureau tables and sometimes incorporate other sources.

10.1.9.3. *Communities and Populations*

This section discusses the estimated population and major communities of Missouri (MO) and includes the following topics:

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

Statewide Population and Population Growth

Table 10.1.9-1 presents the 2014 estimated population and population density of Missouri in comparison to the Central region[119] and the nation. The estimated population of Missouri in 2014 was 6,063,589. The population density was 88 persons per square mile (sq. mi.), which was higher than the population density of the region (66 persons/sq. mi.) and nearly matched the nation's density (90 persons/sq. mi.). In 2014, Missouri was the 18th largest state by estimated population among the 50 states and the District of Columbia, 18th largest by land area, and had the 29th greatest population density (U.S. Census Bureau 2015a, U.S. Census Bureau 2015b).

Table 10.1.9-1: Land Area, Estimated Population, and Population Density of Missouri

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Missouri	68,742	6,063,589	88
Central Region	1,178,973	77,651,608	66
United States	3,531,905	318,857,056	90

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

Estimated population growth is an important subject for this PEIS given FirstNet's mission. Table 10.1.9-2 presents the population growth trends of Missouri from 2000 to 2014 in comparison to the Central region and the nation. The state's annual growth decreased, from 0.68 percent to 0.31 percent, in the 2010 to 2014 period compared to 2000 to 2010. The growth rate of Missouri in the 2010 to 2014 period was slightly lower than the rate of the region (0.45 percent) and was considerably lower than the nation's rate (0.81 percent).

[119] The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. Throughout the socioeconomics section, figures for the Central 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 Central region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

Table 10.1.9-2: Recent Population Growth of Missouri

Geography	Estimated Population			Numerical Estimated Population Change		Rate of Estimated Population Change (AARC)[a]	
	2000	2010	2014	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Missouri	5,595,211	5,988,927	6,063,589	393,716	74,662	0.68%	0.31%
Central Region	72,323,183	76,273,123	77,651,608	3,949,940	1,378,485	0.53%	0.45%
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, 2015aa)

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

Demographers prepare future estimated population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use estimated 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 U.S. Census Bureau does not prepare population projections for the states. Therefore, Table 10.1.9-3 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 (ProximityOne, 2015) (UVA, 2015). 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 Missouri's estimated population will increase by approximately 662,000 people, or 10.9 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.65 percent, which is higher than the historical growth rate from 2010 to 2014 of 0.31 percent but similar to the state's growth rate of 0.68 percent in the 2000 to 2010 period. The projected growth rate of the state in the 2010 to 2014 period is similar to that of the region (0.60 percent) and lower than the projected growth rate of the nation (0.80 percent).

Table 10.1.9-3: Estimated Projected Population Growth of Missouri

Geography	Estimated Population 2014	Projected 2030 Estimated 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) 2014 to 2030
Missouri	6,063,589	6,656,421	6,794,888	6,725,655	662,066	10.9%	0.65%
Central Region	77,651,608	83,545,838	87,372,952	85,459,395	7,807,787	10.1%	0.60%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

Sources: (U.S. Census Bureau, 2015aa; ProximityOne, 2015; UVA, 2015)

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

Population Distribution and Communities

Figure 10.1.9-1 presents the distribution and relative density of the estimated population of Missouri. Each brown dot represents 500 people, and massing of dots indicates areas of higher population density – therefore, areas that are solid in color are particularly high in population density. The map uses ACS estimates based on samples taken from 2009 to 2013 (U.S. Census Bureau, 2015d).

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, 2012; U.S. Census Bureau, 2015e). 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 Missouri has many such small population centers. Dispersed dots indicate dispersed population across the less densely settled areas of the state. Table 10.1.9-4 provides the populations of the 10 largest population concentrations in Missouri, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[120] In 2010, the largest population concentration was the Missouri portion of the St. Louis area, which had approximately 1.8 million people. The second largest population concentration was the Missouri portion of the Kansas City area with 855,909 people. The state had no other population concentrations over 300,000. The smallest of these 10 population concentrations was the Farmington area, with a 2010 population of 39,370 people. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Farmington area, with an annual growth rate of 10.38 percent. This probably reflects the large increase in the U.S. Census Bureau's definition for the Farmington area, which increased from 7 sq. mi. in 2000 to 23 sq. mi. in 2010, more than it reflects organic growth (net in-migration and/or births exceeding deaths). Table 10.1.9-4 also shows that the top 10 population concentrations in Missouri accounted for 57.3 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 70.5 percent of the entire state's growth.

[120] U.S. 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, U.S. Census Bureau classification of a subarea as no longer qualifying as a concentrated population due to population losses, and reclassification by the U.S. 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 10.1.9-4: Population of the 10 Largest Population Concentrations in Missouri

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Cape Girardeau (MO/IL) (MO Portion)	46,626	52,591	53,563	9	5,965	1.21%
Columbia	98,779	124,748	126,872	4	25,969	2.36%
Farmington*	14,660	39,370	40,134	10	24,710	10.38%
Jefferson City	53,714	58,533	58,913	8	4,819	0.86%
Joplin	72,089	82,775	81,759	6	10,686	1.39%
Kansas City (MO/KS) (MO Portion)	799,293	855,909	860,132	2	56,616	0.69%
Lee's Summit*	55,285	85,081	84,960	5	29,796	4.41%
Springfield	215,004	273,724	277,780	3	58,720	2.44%
St. Joseph (MO/KS) (MO Portion)	76,209	78,808	79,271	7	2,599	0.34%
St. Louis (MO/IL) (MO Portion)	1,720,271	1,777,811	1,783,586	1	57,540	0.33%
Total for Top 10 Population Concentrations	3,151,930	3,429,350	3,446,970	NA	277,420	0.85%
Missouri (statewide)	5,595,211	5,988,927	6,007,182	NA	393,716	0.68%
Top 10 Total as Percentage of State	56.3%	57.3%	57.4%	NA	70.5%	NA

Sources: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015g)

AARC = Average Annual Rate of Change (compound growth rate)
*The large population increases from 2000 to 2010 reflect large increases in the area definition for these areas. For example, for the Farmington urban cluster, the area increased from 7 sq. mi. in 2000 to 23 sq. mi. in 2010.

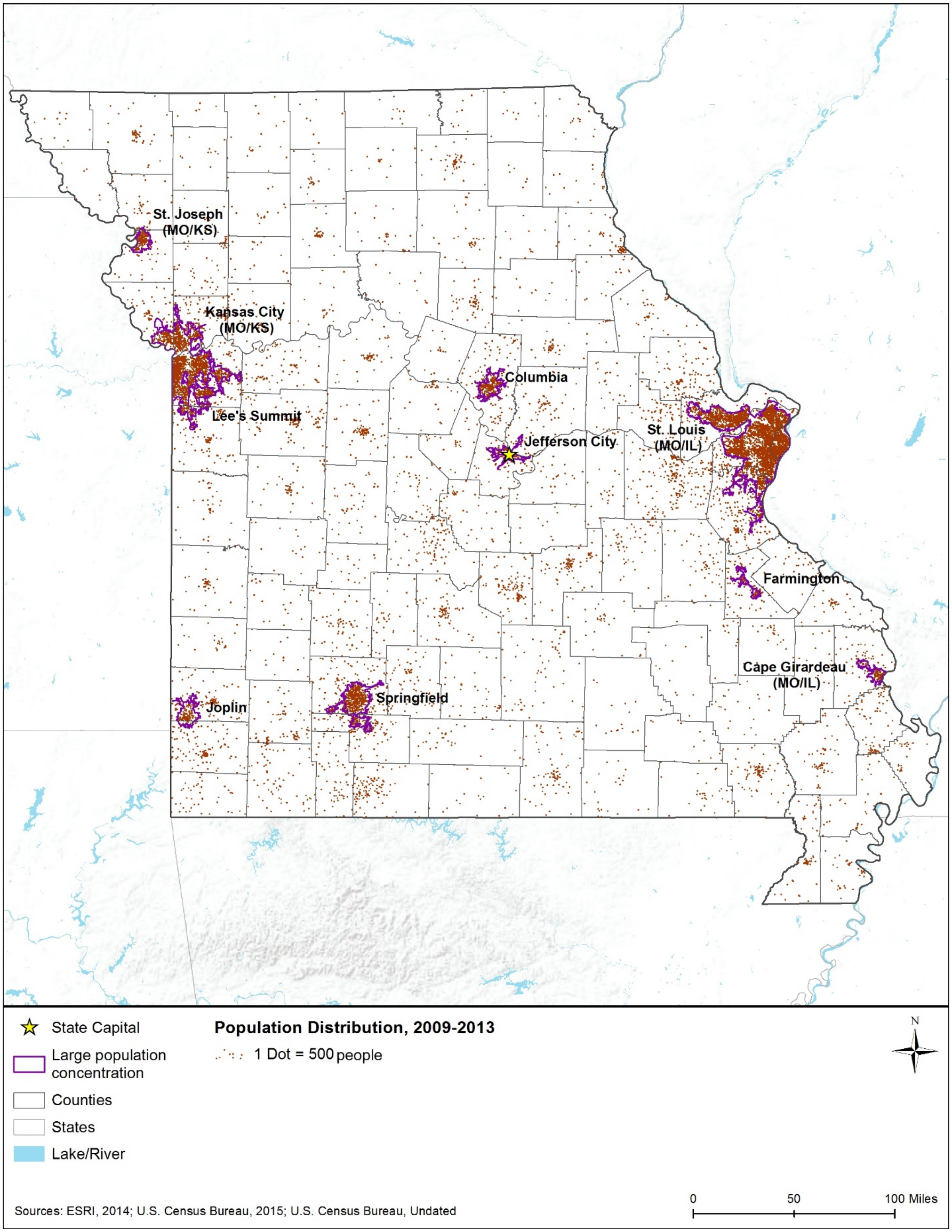

Figure 10.1.9-1: Estimated Population Distribution in Missouri, 2009–2013

10.1.9.4. *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 Proposed Actions are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 10.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of Proposed Actions.

Economic Activity

Table 10.1.9-5 compares several economic indicators for Missouri to the Central region and the nation. The table presents two indicators of income[121] – 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 10.1.9-5, the per capita income in Missouri in 2013 ($25,384) was $2,144 lower than that of the region ($27,528), and $2,800 lower than that of the nation ($28,184). (BLS, 2015b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

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 10.1.9-5 shows that in 2013, the MHI in Missouri ($46,905) was $5,140 lower than that of the region ($52,045), and $5,345 lower that of the nation ($52,250). (BLS, 2015b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

[121] The U.S. 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, 2015h)

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 10.1.9-5 compares the unemployment rate in Missouri to the Central region and the nation. In 2014, Missouri's statewide unemployment rate of 6.1 percent was slightly higher than the rate for the region (5.7 percent) and similar to the rate for the nation (6.2 percent).[122] (BLS, 2015b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

Table 10.1.9-5: Selected Economic Indicators for Missouri

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Missouri	$25,384	$46,905	6.1%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015b; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

Figure 10.1.9-2 and Figure 10.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015i) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 10.1.9-1 (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). Following these two maps, Figure 10.1.9-3 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 Missouri.

Figure 10.1.9-2 shows that in 2013 the vast majority of counties in Missouri had MHI levels below the national average. Only a few counties, mainly located around the two largest population concentrations (Missouri portions of the St. Louis and Kansas City areas), had MHI levels above the national average. Table 10.1.9-6 shows that the 2009-2013 MHI levels in the 10 population concentrations varied considerably compared to the statewide figure of $47,380, ranging from $35,230 in the Farmington area to $76,704 in the Lee's Summit area.

Figure 10.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state, including most of the counties around the top 10 population concentrations. The highest unemployment rates were generally in the counties located in the south-central and southeastern portions of the state. Table 10.1.9-6 shows that 2009–2013 unemployment rates varied across the 10 largest population concentrations, with four of these areas having unemployment rates that were higher than the state average, and six having lower unemployment rates.

[122] The timeframe for unemployment rates can change quarterly.

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 10.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the U.S. Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers in Missouri matched the percentage for the Central region, and was slightly higher than the nation's percentage. The percentages of government workers and self-employed workers nearly matched the percentages for the region, and were lower than the nation's figures.

By industry, Missouri has a mixed economic base and some notable figures in the table are as follows. In 2013, Missouri had a considerably lower percentage of persons working in "manufacturing" than did the region. It also had a notably lower percentage of workers in "professional, scientific, management, administrative, and waste management services" than the nation. The percentages for the remaining industries were within one percentage point of the regional value.

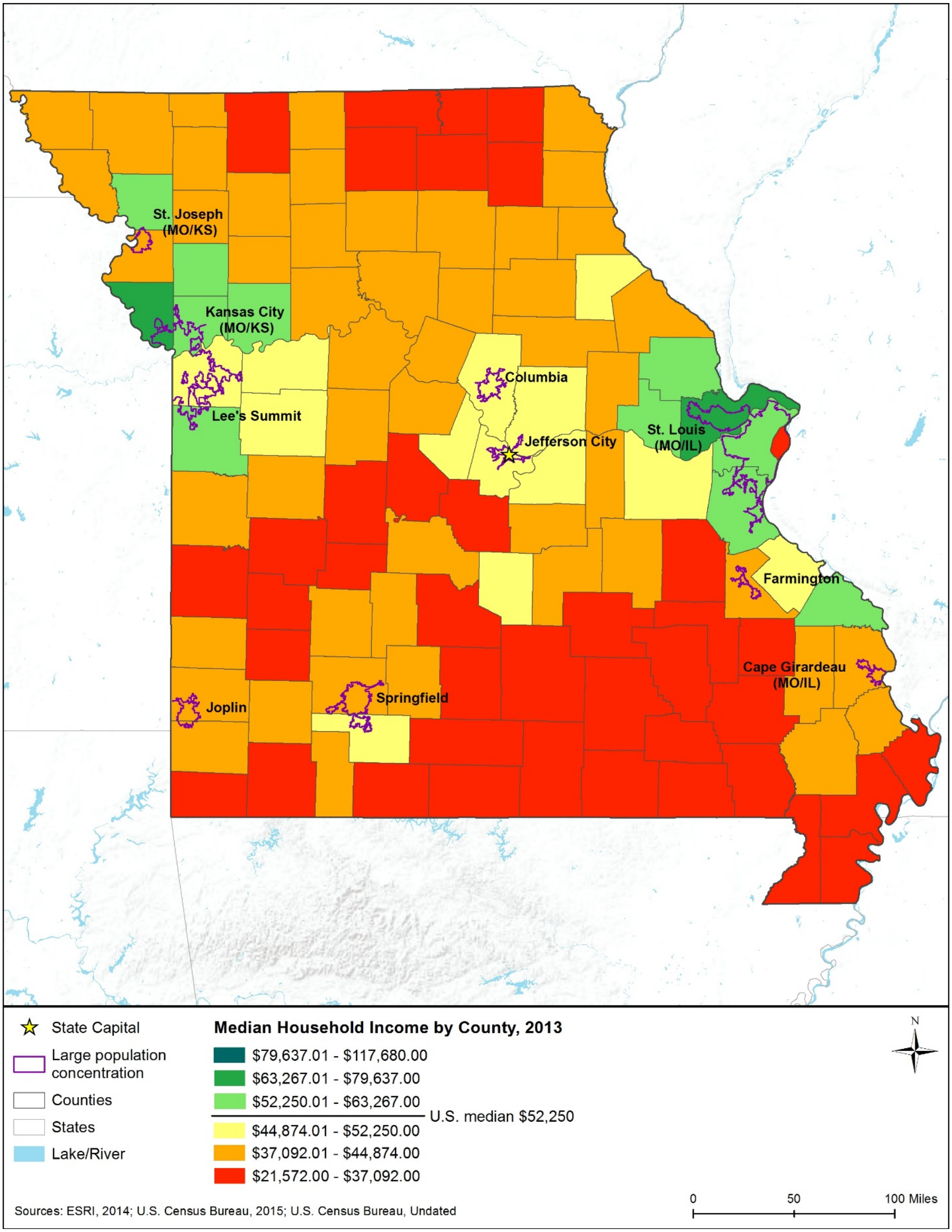

Figure 10.1.9-2: Median Household Income in Missouri, by County, 2013

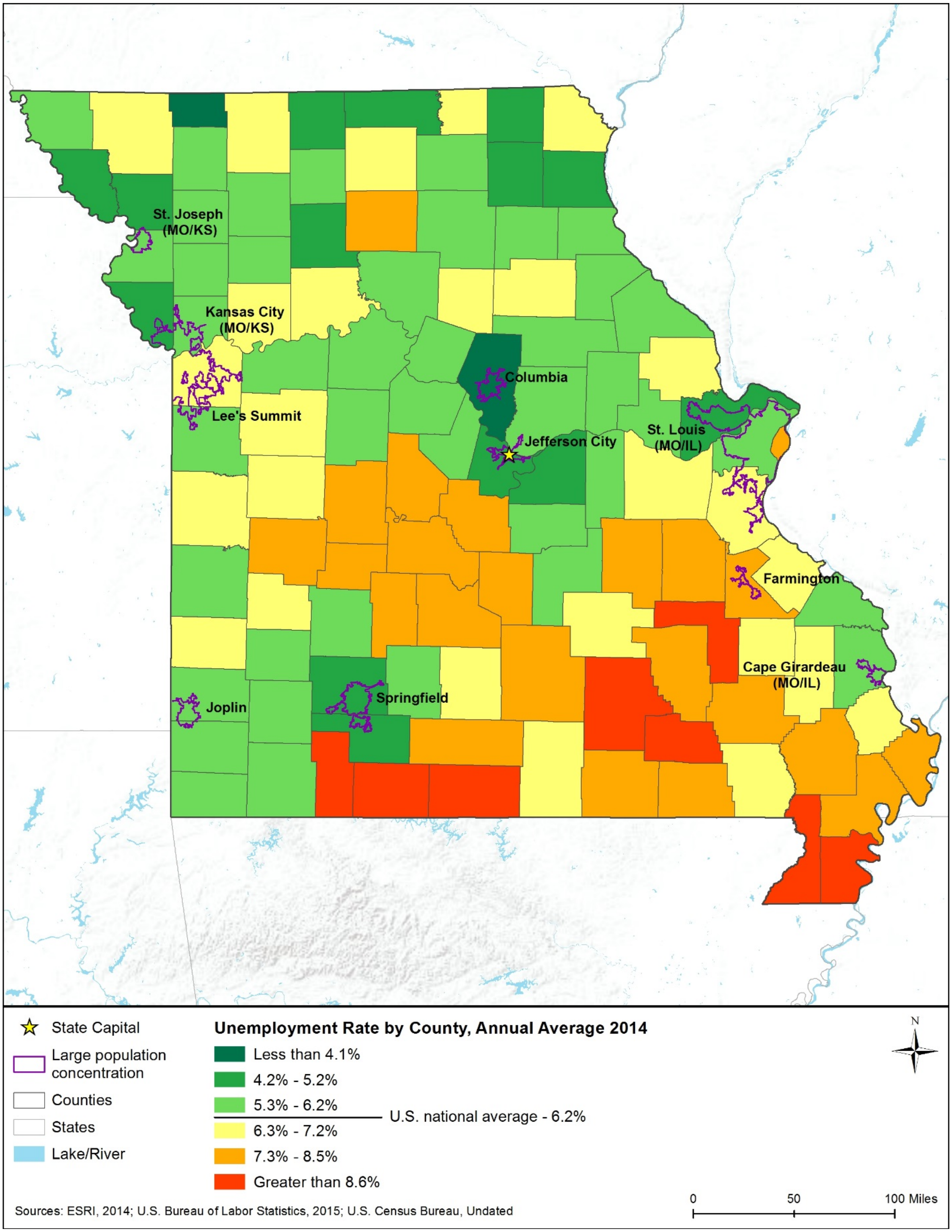

Figure 10.1.9-3: Unemployment Rates in Missouri, by County, 2014

Table 10.1.9-6 Selected Economic Indicators for the 10 Largest Population Concentrations in Missouri, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Cape Girardeau (MO/IL) (MO Portion)	$43,181	7.5%
Columbia	$43,494	6.3%
Farmington	$35,230	10.5%
Jefferson City	$49,966	5.0%
Joplin	$39,681	8.3%
Kansas City (MO/KS) (MO Portion)	$49,040	9.0%
Lee's Summit	$76,704	5.4%
Springfield	$40,148	8.5%
St. Joseph (MO/KS) (MO Portion)	$42,664	9.0%
St. Louis (MO/IL) (MO Portion)	$55,048	9.4%
Missouri (statewide)	$47,380	8.8%

Source: (U.S. Census Bureau, 2015l)

Table 10.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Missouri	Central Region	United States
Civilian Employed Population 16 Years and Over	2,808,535	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	81.7%	81.7%	79.7%
Government workers	12.7%	12.8%	14.1%
Self-employed in own not incorporated business workers	5.5%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.8%	2.2%	2.0%
Construction	5.8%	5.6%	6.2%
Manufacturing	11.4%	14.0%	10.5%
Wholesale trade	2.5%	2.7%	2.7%
Retail trade	12.1%	11.5%	11.6%
Transportation and warehousing, and utilities	5.2%	4.9%	4.9%
Information	2.1%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	6.8%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	9.4%	9.7%	11.1%
Educational services, and health care and social assistance	24.1%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.4%	9.1%	9.7%
Other services, except public administration	4.9%	4.6%	5.0%
Public administration	4.3%	3.9%	4.7%

Source: (U.S. Census Bureau, 2015m)

Table 10.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the U.S. Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 10.1.9-7 for 2013.

Table 10.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Missouri, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Cape Girardeau (MO/IL) (MO Portion)	5.4%	3.4%	1.8%	7.5%
Columbia	3.2%	2.6%	2.2%	7.9%
Farmington	5.5%	6.5%	0.5%	7.7%
Jefferson City	5.6%	3.6%	2.6%	8.8%
Joplin	4.7%	4.6%	2.7%	7.2%
Kansas City (MO/KS) (MO Portion)	5.7%	5.7%	2.7%	11.9%
Lee's Summit	5.8%	4.1%	4.0%	12.0%
Springfield	4.5%	4.7%	2.4%	9.1%
St. Joseph (MO/KS) (MO Portion)	4.8%	4.5%	1.7%	6.7%
St. Louis (MO/IL) (MO Portion)	4.8%	4.6%	2.4%	11.4%
Missouri (statewide)	6.1%	5.1%	2.1%	9.1%

Source: (U.S. Census Bureau, 2015l)

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 10.1.9-9 compares Missouri to the Central region and nation on several common housing indicators.

As shown in Table 10.1.9-9, in 2013, Missouri had a slightly lower percentage of housing units that were occupied (86.9 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Missouri had a somewhat lower percentage of owner-occupied units (67.0 percent) than the region (67.6 percent), and a higher percentage when compared to the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in 2013 is higher in Missouri (70.0 percent) than in the region (67.7 percent) and nation (61.5 percent). The homeowner vacancy rate in Missouri (2.2 percent) was slightly higher than the rate for the region (1.8 percent) and the nation (1.9 percent). This rate reflects "vacant units that are 'for sale only' (U.S. Census Bureau, 2015h). The vacancy rate among rental units was slightly higher in Missouri (6.9 percent) than in the region (6.0 percent) and the nation (6.5 percent).

Table 10.1.9-9: Selected Housing Indicators for Missouri, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Missouri	2,719,109	86.9%	67.0%	2.2%	6.9%	70.0%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

Source: (U.S. Census Bureau, 2015n)

Table 10.1.9-10 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 10.1.9-10 shows that during this period, the percentage of occupied housing units ranged from 86.7 to 93.1 percent across these population concentrations.

Table 10.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Missouri, 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
Cape Girardeau (MO/IL) (MO Portion)	23,200	90.3%	59.1%	4.6%	7.2%	65.4%
Columbia	53,953	92.8%	49.8%	1.6%	4.6%	53.5%
Farmington	15,670	90.3%	59.0%	3.2%	7.8%	66.5%
Jefferson City	25,866	90.7%	60.4%	1.5%	2.1%	64.3%
Joplin	36,998	88.8%	60.5%	3.2%	6.3%	75.6%
Kansas City (MO/KS) (MO Portion)	393,848	88.1%	61.5%	2.4%	9.9%	66.6%
Lee's Summit	33,402	93.1%	75.8%	1.5%	8.5%	76.0%
Springfield	125,464	91.5%	57.0%	2.5%	9.0%	69.1%
St. Joseph (MO/KS) (MO Portion)	34,090	86.7%	61.7%	2.6%	7.8%	70.1%

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
St. Louis (MO/IL) (MO Portion)	796,508	90.0%	68.0%	2.5%	7.8%	65.8%
Missouri (statewide)	2,713,829	87.0%	68.4%	2.4%	7.5%	70.2%

Source: (U.S. Census Bureau, 2015o)

Property Values

Property values have important relationships to both the wealth and affordability of communities.

Table 10.1.9-10 provides indicators of residential property values for Missouri and compares these values to values for the Central region and nation. The figures on median value of owner-occupied units are from the U.S. 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, 2015h).

The table shows that the median value of owner-occupied units in Missouri in 2013 ($133,200) was lower than the corresponding values for the Central region ($151,200) and for the nation ($173,900).

Table 10.1.9-10: Residential Property Values in Missouri, 2013

Geography	Median Value of Owner-Occupied Units
Missouri	$133,200
Central Region	$151,200
United States	$173,900

Source: (U.S. Census Bureau, 2015n)

Table 10.1.9-11 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. The median property value for these 10 communities ranged from $93,200 in the Farmington area to $176,900 in the Lee's Summit area, the state value was $137,000. The lowest property values were in the two areas – Farmington and Joplin – that had the lowest median household incomes (Table 10.1.9-6).

Table 10.1.9-11: Residential Property Values for the 10 Largest Population Concentrations in Missouri, 2009–2013

Area	Median Value of Owner-Occupied Units
Cape Girardeau (MO/IL) (MO Portion)	$132,600
Columbia	$162,800
Farmington	$93,200
Jefferson City	$136,200
Joplin	$100,000
Kansas City (MO/KS) (MO Portion)	$131,100
Lee's Summit	$176,900
Springfield	$124,900
St. Joseph (MO/KS) (MO Portion)	$105,200
St. Louis (MO/IL) (MO Portion)	$167,200
Missouri (statewide)	$137,000

Source: (U.S. Census Bureau, 2015o)

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 10.1.9-12 presents total and selected state and local government revenue sources as reported by the U.S. 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 estimated 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 10.1.9-12 shows that the state government in Missouri received less total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Missouri local governments received more total revenue per capita in 2012 than their counterparts in the region, but less total revenue than their counterparts in the nation. Missouri state government had higher levels per capita of intergovernmental revenue[123] than its counterparts in the region and nation. Local governments in Missouri received higher levels per capita of intergovernmental revenues from the federal government when compared to counterparts in the region, and lower levels when compared to counterparts in the nation. The state government in Missouri obtained considerably lower levels of property taxes per capita than its counterparts in the region and nation. Local governments in Missouri obtained higher levels of property taxes, per capita, than local governments in the region, and lower levels than their counterparts in the nation. The Missouri state government reported lower revenue from general and selective sales taxes than its counterparts in the region and nation. Local governments in Missouri, on the other hand, reported higher revenue from general and selective sales taxes than their counterparts in the region and nation. The state government in Missouri reported no revenue from public utility taxes. Public utility taxes on a per capita basis were higher for local governments in Missouri than for their counterparts in the region and nation. Individual income tax revenues, on a per capita basis, were lower for Missouri state and local governments than for those governments in the region and nation. The state government in Missouri reported lower levels of corporate income tax revenues, on a per capita basis, than its counterparts in the region and nation. Local governments in Missouri reported minimal corporate income tax revenues.

Table 10.1.9-12: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	Missouri		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue ($M)	$31,066	$24,930	$463,192	$231,980	$1,907,027	$1,615,194
Per capita	$5,159	$4,140	$6,020	$3,015	$6,075	$5,145
Intergovernmental from Federal ($M)	$10,441	$952	$125,394	$9,383	$514,139	$70,360
Per capita	$1,734	$158	$1,630	$122	$1,638	$224
Intergovernmental from State ($M)	$0	$6,195	$0	$76,288	$0	$469,147
Per capita	$0	$1,023	$0	$992	$0	$1,495
Intergovernmental from Local ($M)	$374	$0	$2,721	$0	$19,518	$0
Per capita	$62	$0	$35	$0	$62	$0
Property Taxes ($M)	$29	$5,726	$3,626	$61,015	$13,111	$432,989
Per capita	$5	$951	$47	$793	$42	$1,379
General Sales Taxes ($M)	$3,103	$2,113	$58,236	$6,920	$245,446	$69,350
Per capita	$515	$352	$757	$90	$782	$221

[123] 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)

Type of Revenue	Missouri		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Selective Sales Taxes ($M)	$1,662	$709	$33,313	$2,191	$133,098	$28,553
Per capita	$276	$118	$433	$28	$424	$91
Public Utilities Taxes ($M)	$0	$496	$3,627	$1,153	$14,564	$14,105
Per capita	$0	$82	$47	$15	$46	$45
Individual Income Taxes ($M)	$5,132	$321	$72,545	$5,148	$280,693	$26,642
Per capita	$852	$53	$943	$67	$894	$85
Corporate Income Taxes ($M)	$302	$76	$9,649	$310	$41,821	$7,210
Per capita	$50	$13	$125	$4	$133	$23

Sources: (U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q)

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

10.1.10. Environmental Justice

10.1.10.1. *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). The fundamental principle of environmental justice is, “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 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’s Office of Environmental Justice (USEPA, 2015e) offers guidance on Environmental Justice issues and provides an “environmental justice screening and mapping tool,” EJSCREEN (USEPA, 2015f).

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 U.S. 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).

10.1.10.2. *Specific Regulatory Considerations*

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to environmental justice for this PEIS. The Missouri Department of Natural Resources (MDNR), in its Fiscal Year 2000 Integrated Strategic Plan included an environmental justice strategy and objectives aimed at promoting awareness of resource issues. "MDNR sought to measure progress in reaching its environmental justice objectives by finding an increase in the number of environmental permits issued "which include[d] consideration of the impact on minority and low income populations" as well as captured the "[d]emographics of groups involved in policy and operational decisions. (University of California, Hastings College of Law, 2010)." Subsequent Plans do not refer expressly to environmental justice. (University of California, Hastings College of Law, 2010)

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

Table 10.1.10-1 presents 2013 data on the composition of Missouri's estimated population by race and by Hispanic origin. The state's estimated population has a higher percentage of individuals who identify as Black / African American (11.5 percent) than the estimated population of the Central region (9.3 percent), but slightly lower percentage when compared to the nation (12.6 percent). The state's population has lower percentages of individuals who identify as Asian (1.7 percent), or Some Other Race (1.1 percent) than the populations of the Central region and the nation. Those percentages are for Asian, 2.8 percent for the Central region, and 5.1 percent for the nation; and for Some Other Race, 2.4 percent and 4.7 percent, respectively. The state's estimated population of persons identifying as White (82.8 percent) is similar to that of the Central region (82.2 percent) and larger than that of the nation (73.7 percent).

The percentage of the estimated population in Missouri that identifies as Hispanic (3.8 percent) is significantly lower than in the Central region (8.5 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. Missouri's All Minorities estimated population percentage (19.6 percent) is lower than that of the Central region (23.3 percent) and considerably lower than that of the nation (37.6 percent).

Table 10.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Missouri (15.9 percent) is slightly higher than that for the Central region (14.7 percent) and nearly matches the nation's (15.8 percent).

Table 10.1.10-1: Estimated Population by Race and Hispanic Status, 2013

Geography	Total Estimated Population	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Missouri	6,044,171	82.8%	11.5%	0.4%	1.7%	0.1%	1.1%	2.5%	3.8%	19.6%
Central Region	77,314,952	82.2%	9.3%	0.7%	2.8%	0.1%	2.4%	2.5%	8.5%	23.3%
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, 2015r)

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

Table 10.1.10-2: Percentage of Estimated Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Missouri	15.9%
Central Region	14.7%
United States	15.8%

Source: (U.S. Census Bureau, 2015s)

10.1.10.4. *Environmental Justice Screening Results*

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the Proposed Action 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 10.1.10-1 visually portrays the results of the environmental justice population screening analysis for Missouri. The analysis used block group data from the U.S. Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015t; U.S. Census Bureau, 2015u; U.S. Census Bureau, 2015v) and U.S. Census Bureau urban classification data (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015e). Figure 10.1.10-1 shows that Missouri has many areas with high and moderate potential for environmental justice populations. The distribution of these high and moderate potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations.

It is important to understand how the data behind Figure 10.1.10-1 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 10.1.10-1 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 Proposed Actions, 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 Proposed Actions 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, significant (according to NEPA 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 10.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

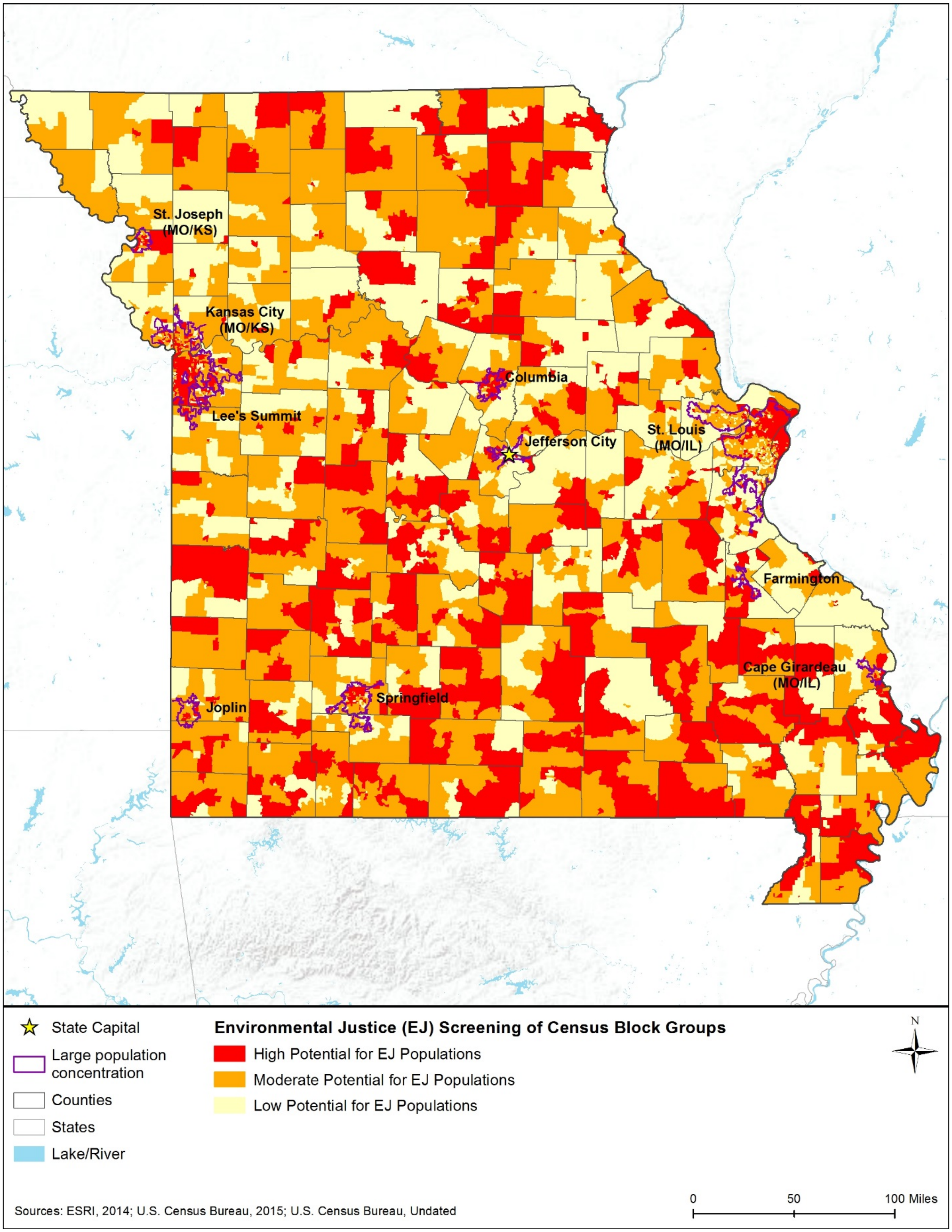

Figure 10.1.10-1: Potential for Environmental Justice Populations in Missouri, 2009–2013

10.1.11. Cultural Resources

10.1.11.1. *Definition of Resource*

For the purposes of this Programmatic Environmental Impact Statement (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 National Register of Historic Places (NRHP).

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

- Statutory language and implementing regulations for Section 106 of the NHPA, 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 (ARPA), 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 (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS's program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015k); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

10.1.11.2. *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 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), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Missouri does not have state regulations that are similar to NEPA or the NHPA. 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 10.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 10.1.11-1: Relevant Missouri Cultural Resources Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
MRS, Chapter 253.408-412	MDNR	Establishes the "State Historic Preservation Act" and designates the Director of the MDNR as the State Historic Preservation Officer. Also establishes the State Historic Preservation Office (SHPO) within the MDNR to establish, implement, and review federally-funded or permitted programs state programs and plans for historic preservation.
MRS, Chapter 253.415.1	Local governments	Establishes the "Local Historic Preservation Act" and provides the authority for local governments to create historic preservations commissions empowered to carryout historical preservation responsibilities including surveying resources with "scenic significance to the locality, state, or nation."
MRS, Chapter 253	MDNR	Gives authority for administration of state parks and NHPA to MDNR.

10.1.11.3. *Cultural and Natural Setting*

Human beings have inhabited the Missouri region for at least 14,000 years. The majority of early human habitation evidence in Missouri comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 10 archaeological sites listed on the NRHP, 9 of which are prehistoric, and 1 site that is historic. (NPS, 2015c)

Archaeologists typically divide large study areas into regions. Missouri is comprised of the Physiographic Regions of the Atlantic Plain, Interior Highlands, and the Interior Plains. The Physiographic Provinces are identical to the Physiographic Regions and are comprised of the Coastal Plains, Ozark Plateau, and the Central Lowland respectively, as shown in Figure 10.1.3-1 of this document.

Evidence from most archeological sites in Missouri is in relatively shallow deposits that are either 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 1-10 feet below the current surface, with older sites in the deeper sediments. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas. (Pauketat, 2012)

The following sections provide additional detail about Missouri's prehistoric periods of approximately 12000 B.C. to A.D. 1600 and the historic period since European colonization in the 1600s. There is some overlap between the prehistoric period and the historic period, as American Indians continued to carry on their way of life in parts of Missouri after European contact. Section 10.1.11.4 presents an overview of the initial human habitation in Missouri and the cultural development that occurred before European contact. Section 10.1.11.4 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 10.1.11.5 provides a current list of significant archaeological sites in Missouri and tools that the state has developed to ensure their preservation. Section 10.1.11.6 documents the historic context of the state since European contact, and Section 10.1.11.7 summarizes the architectural context of the state during the historic period.

10.1.11.4. *Prehistoric Setting*

There is debate about when the first human inhabitants arrived in Missouri. Some scientists suggest human occupation began as early as 18,000 years ago, but the evidence has not yet been completely accepted (Missouri Archaeological Society, 2015). Archaeologists divide Missouri's known prehistoric past into four periods: The Paleoindian Period (12000 - 8000 B.C.), Archaic Period (8000 - 1000 B.C.), Woodland Period (1000 B.C. - A.D. 900), and the Mississippian Period (A.D. 1000 - 1600). Figure 10.1.11-1 shows a timeline representing these periods of early human habitation of present day Missouri. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation is prevalent in each of Missouri's physiographic regions. Due to advancements in techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record, the periods associated with a particular time in North American human development continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

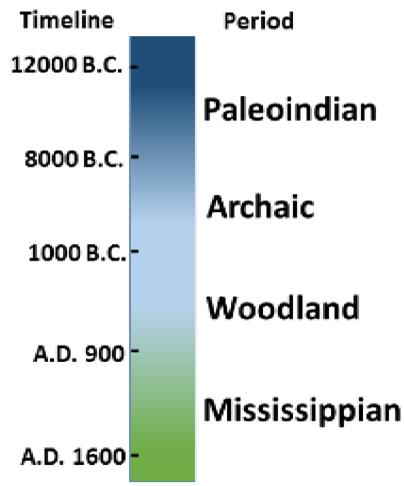

Figure 10.1.11-1: Timeline of Prehistoric Human Occupation

Source: (Institute of Maritime History, 2015; Missouri Archaeological Society, 2015)

Paleoindian Period (12000 - 8000 B.C.)

The Paleoindian Period represents the earliest human habitation of Missouri. The earliest people to occupy the state were small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear points, also referred to as the Clovis or Folsom fluted point. Studies show that that such technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002; Missouri Archaeological Society, 2015).

During the Paleoindian period, there was a major shift in the climate and many large mammals, which are now extinct, such as giant bison, mammoths, and mastodon were being hunted. To supplement their diet, the people of the Paleoindian period foraged for wild plant berries, seeds, roots; small animals; and clams. A site in Kimmswick, MO, provides direct evidence that these early people were hunting American mastodon. The stone tools found at the site are associated with the Clovis and Folsom culture that manufactured distinctive fluted spear points (Graham, Haynes, & Johnson, 1981; Missouri Archaeological Society, 2015).

The artifacts from the Paleoindian period are not evenly distributed in Missouri, and vary in accordance with geographic and topographic factors. Out of the 11,257 projectile points known to exist in the United States dating from the Paleoindian period, 300 of them come from Missouri, and have been found in all the counties in the state. The majority of the fluted points documented in the United States are from east of the Mississippi River (Anderson & Faught, 1998; Bray, 1963).

The Big Eddy site is a multicomponent Paleoindian occupation site in southwest Missouri. Very few sites such as this have been discovered in North America. The site represents human occupation throughout the Paleoindian period, and is important because it provides archaeologists with a stratified archaeological deposits of early human occupation in North America (Ray, Lopinot, Hajic, & Mandel, 1998).

Archaic Period (8000 - 1000 B.C.)

The climate in Missouri experienced a warming trend due to the ending of the last Ice Age. As plants became more abundant during this period, there was as shift in the hunting and gathering practices. The people relied more heavily on edible plants that were gathered, while supplementing their diet with whatever small game they could catch. "This time period coincides with warm and dry climatic conditions. Evidence indicates that prairies expanded at the expense of the forested regions. Deer herds may have decreased, and the Middle Archaic diet included greater amounts of birds, fish, and rabbits." (Missouri Archaeological Society, 2015).

A trend towards as less nomadic and more sedentary lifestyle took place during the Archaic. The discovery of plant grinding implements, increases in human populations, and semi-permanent and permanent settlements provide archaeologists with the evidence for understanding how the people lived during the Archaic period. Stone tools manufactured for various uses have been discovered and people were using the atlatl[124] or spear thrower during the Archaic (Jefferies, 1995).

By the Middle Archaic period, the climate was conducive for a forested environment and the vegetation was much like present day Missouri (Chomko, 1978). Plant and animal species were abundant, which provided an opportunity for the expansion of resource exploitation, which was

[124] The atlatl javelin was a spear-throwing device with a stone weight. The weight was placed on a narrow board, which works like a lever, and the device projected out behind the throwing hand, permitting the javelin resting into its end to be hurled with greater force and precision. (Bolton, 1971; Ritchie, 1969)

enhanced by advancement of tool technologies such as spear points, groundstones, axes, and other food processing implements (Missouri Archaeological Society, 2015).

The Barrington site in eastern Missouri provides evidence from the Middle Archaic from two pit excavations. Artifacts discovered at the site include a variety of stone tools such as hammer stones and notched projectile points. Artifacts found at both pits are believed to have been placed there by the same group of people (Martin, 2001).

By the Late Archaic period, the people were manufacturing pottery, which is considered a major advancement of human culture in North America. The use of pottery coincides with the cultivation of plants as a food source. Squash and bottle gourd are two types of plants that were domesticated and harvested for consumption during the Late Archaic period (Missouri Archaeological Society, 2015; Jefferies, 1995). "Social changes occurred during the Late Archaic period, as reflected by the first large village sites and elaborate burial rituals. The Hatten mound, constructed in northeast Missouri during the Late Archaic, is the oldest documented burial mound in the state. Different burial patterns and variations in stone tools reflect three or four distinct Missouri tribes" (Missouri Archaeological Society, 2015).

Woodland Period (1000 B.C. - A.D. 900)

Pottery manufacture became widespread across the region during the Woodland Period. The bow and arrow had all but completely replaced the atlatl as a preferred method for hunting, which is evidenced by the decrease in the size of stone spear point (referred to today as arrowheads). During the early part of the Woodland Period, people primarily lived in seasonal camps much like during the late Archaic, and the climate was much like the current conditions in the region. Sustenance provided by deer, bison, and other animals was increasingly being augmented by edible wild plants (Wood, 1973).

By the late Woodland Period, societies became more sedentary, and agriculture was being practiced as a substantial means for subsistence. Corn, beans, and other cultivated plants that were originally domesticated in other tropical regions of North America were commonly being exploited agriculturally (Whittaker, 2005; Benn & Ray, 1996). Tool technology continued to advance during the late Woodland period and the use of ceramics continued to increase (Missouri Archaeological Society, 2015; Whittaker, 2005; Benn & Ray, 1996).

Mississippian Period (A.D. 1000 - 1600)

The Mississippian Period of North American archaeology began its development in the Mississippi River's American Bottom floodplain area in Illinois and Missouri near St. Louis (Bense, 1996). Populations continued to increase during the Mississippian Period as the people became more sedentary. Permanent or year-round occupation of sites in Missouri have been well documented. "This time period is marked by large permanent villages where populations relied upon the cultivation of corn as a major component of their diet. Villages grew in population and wealth and became large, fortified towns with impressive temple mounds, plazas, and astronomical observatories." (Missouri Archaeological Society, 2015)

Shell tempered pottery found at various sites in Missouri has provided evidence that people were improving their technological capabilities. A distinct form of small triangular arrow points are prevalent from this period, and show a transition of an emerging Mississippian culture. Conch shells, evidencing regional trade to the Gulf of Mexico and the Atlantic Ocean, and embossed Mississippian copper plates originating in the Great Lakes region are a few items that have been discovered in Missouri (Lynott, 1991; Missouri Archaeological Society, 2015).

Numerous surveys along the Ozark National Scenic Riverways of southeast Missouri have provided important information on how the people of the Mississippian Period lived (Lynott, 1982). "New populations with distinctive pottery and stone tool technology immigrated into Missouri during the fourteenth century. Termed Oneota culture by archaeologists, the new population identified themselves as the Wah-Sha-She and Niutachi. Today, they are known by the names Osage and Missouri" (Missouri Legislature, 2015a).

10.1.11.5. *Federally Recognized Tribes of Missouri*

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are currently no federally recognized American Indian tribes in Missouri (National Conference of State Legislators, 2015; U.S. Government Publishing Office, 2015). General locations of tribes known to have historically existed in this region of the United States are depicted in Figure 10.1.11-2.

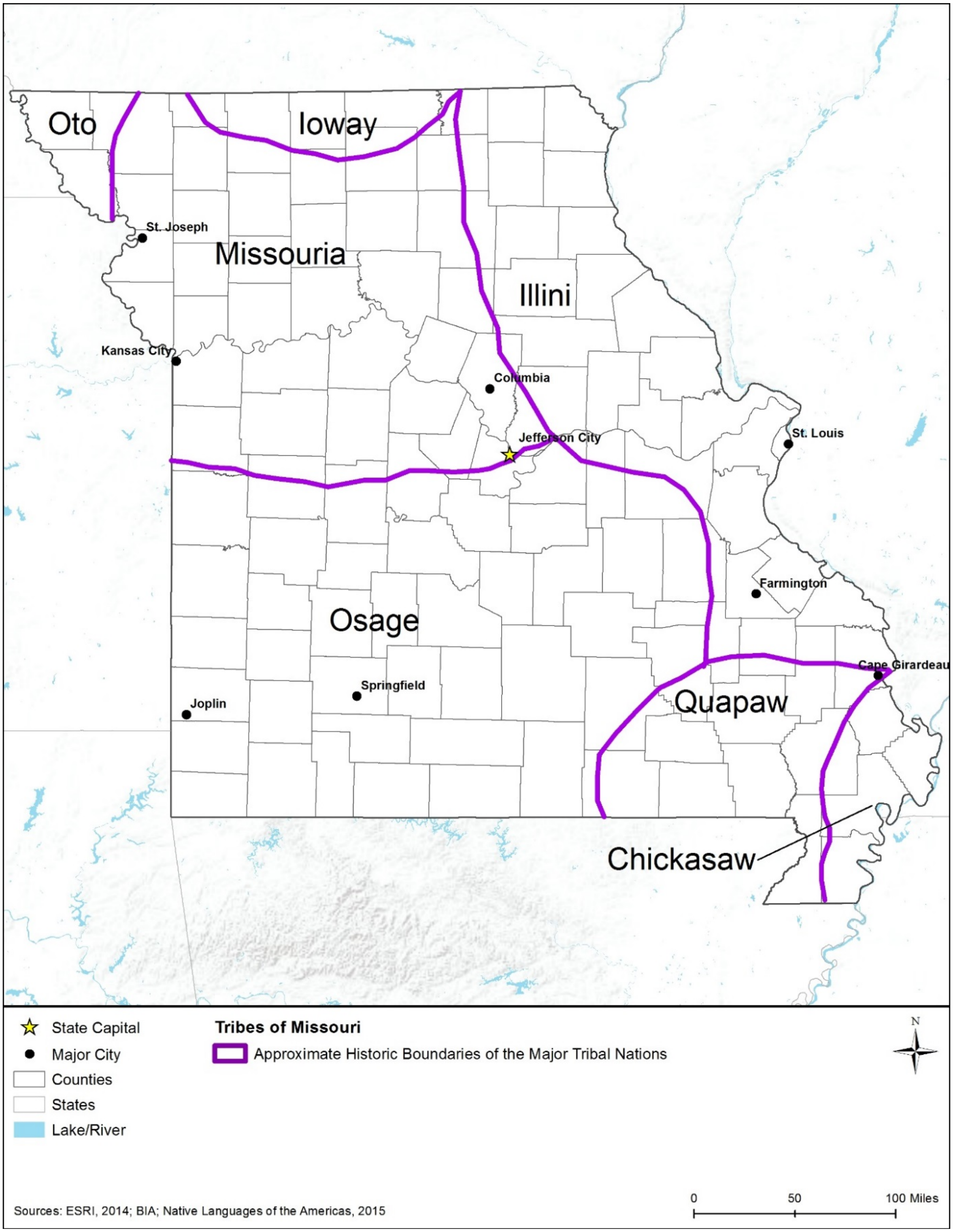

Figure 10.1.11-2: Approximate Boundaries of Historic Tribal Areas in Missouri

10.1.11.6. *Significant Archaeological Sites of Missouri*

As previously mentioned in Section 10.1.11.3 there are 10 archaeological sites in Missouri listed on the NRHP. Table 10.1.11-2 lists the names of the sites, the city they are closest to, and type of site.

The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2014e).

Missouri State Cultural Resources Database and Tools

Missouri State Historic Preservation Office (SHPO)
The State Historic Preservation Office, which is part of the Missouri Department of Natural Resources, works to preserve the cultural resources of the state. The office is responsible for overseeing preservation programs and maintaining archaeological and architectural survey inventories, some of which are available online at http://dnr.mo.gov/shpo/.

The Missouri Archaeological Society
The Missouri Archaeological Society, established in 1935 as a not-for-profit educational organization, has information available online on both the prehistoric periods of the state (http://associations.missouristate.edu/mas/archaeologyinmo.html) and artifact identification (http://associations.missouristate.edu/mas/identification.html). The Archaeological Society is currently housed at Missouri State University in Springfield, MO.

Table 10.1.11-2: Archaeological Sites on the National Register of Historic Places in Missouri

Closest City	Site Name	Type of Site
Caruthersville	Murphy Mound Archeological Site	Prehistoric
Columbia	Gordon Tract Archaeological Site	Prehistoric
Cooter	Campbell Archaeological Site	Prehistoric
Jefferson County	Mastodon State Historic Site	Prehistoric
Liberty	Nebo Hill Archeological Site	Prehistoric
Marmaton River	Carrington Osage Village Site	Historic Indian
Marshall	Utz Site	Prehistoric
Mineola	Graham Cave	Prehistoric
Portland	Research Cave	Prehistoric
St. Louis	Sugarloaf Mound	Prehistoric

Source: (NPS, 2014e)

10.1.11.7. *Historic Context*

Missouri was first explored in 1673 by Louis Joliet and Father Jacques Marquette as they traveled down the Mississippi River. In 1682, Rene Robert Cavelier, Sieur de La Salle claimed the land that is now Missouri for France, where it remained until 1762 when it transferred to

Spain. While early 18th century settlements were attempted, the first permanent European settlement was Ste. Genevieve (1750). St. Louis, near the junction of the Mississippi and Missouri Rivers, was founded in 1764 by Pierre Laclede Liguest (Missouri Digital Heritage, 2015a). Lead was discovered in Missouri during the 18th century and would be important for its economy for many years, along with zinc and coal. After control transferred from Spain back to France in 1800, Missouri was acquired by the U.S. as a part of the Louisiana Purchase is 1803 (Missouri State Historic Preservation Office, 2011).

In 1804, Louis and Clark's Corps of Discovery departed from St. Louis, spending significant time exploring the Missouri region. In1805, St. Louis was chosen as the capital of the Territory of Louisiana (Missouri Digital Heritage, 2015b). St. Louis became the center of economic activity as a shipping and transportation hub, point of departure for western settlement, and eventually an industrial center (Missouri State Historic Preservation Office, 2011). In 1812, the Territory of Missouri was created out of the Territory of Louisiana, and on August 10, 1821, Missouri entered the Union as the 24th state; in 1826, Jefferson City was chosen as the new capital (Missouri Digital Heritage, 2015b) (Missouri Digital Heritage, 2015c). Settlers who moved to Missouri came from Tennessee, Kentucky, and other eastern states, as well as from Europe. These people were drawn first by its agricultural potential, and later by its industrial capabilities. Missouri also served as a starting point for westward movement, particularly along the Santa Fe Trail (Missouri State Historic Preservation Office, 2011).

In 1839, the University of Missouri was established in Columbia as "the first state university west of the Mississippi River" (Missouri Digital Heritage, 2015d). Missouri did not secede during the Civil War; however, it remained a slave state. By war's end, "more than 1,000 skirmishes, fights, and battles took place on Missouri soil, more conflicts than any state except Virginia and Tennessee" (Missouri State Historic Preservation Office, 2011). Railroad expansion occurred after the Civil War, with the Pacific Railroad connecting St. Louis and Kansas City; railroads soon surpassed steamboats as the dominant form of transportation in the region. During the late 19th century, farming continued to be important, with many farmers switching to raising livestock instead of growing crops (Missouri State Historic Preservation Office, 2011). Growth continued during the late 19th century, and architects Dankmar Adler and Louis Sullivan's Wainwright Building, built in St. Louis in 1891, was one of the country's earliest skyscrapers (Missouri Digital Heritage, 2015e). During World War I (WWI), Missouri farms and factories increased production, and Missouri men and women served abroad and domestically (Missouri State Historic Preservation Office, 2011). During the Great Depression, unemployed farmers and factory workers were put to work through work relief programs (Missouri State Historic Preservation Office, 2011). One of the large projects completed was the Bagnell Dam (1931), which created "the Lake of the Ozarks, one of the largest artificial lakes in the world" (Missouri Digital Heritage, 2015f).

During World War II (WWII), nearly half a million Missourians joined the military, while domestically, men and women produced food and worked in factories supplying wartime goods. St. Louis was involved in ordinance production, while plants in Kansas City built bombers. Missouri had training camps and prisoner of war (POW) camps as well. Following WWII, large-scale suburban development occurred, both residential and commercial, and while much of this development resulted in the loss of historic resources, many mid-20th century developments are now themselves becoming historic (Missouri State Historic Preservation Office, 2011).

Missouri has 2,224 NRHP listed sites, as well as 37 NHLs (NPS, 2014f). Missouri contains a portion of one National Heritage Area (NHA), the Freedom's Frontier National Heritage Area (NPS, 2015o). Figure 10.1.11-3 shows the location of NHA and NRHP sites within the state.[125]

10.1.11.8. *Architectural Context*

The first European forms of architecture in Missouri were constructed by the French during the 18th century. Early settlements, such as Ste. Genevieve, still contain examples of French Colonial architecture. "The town retains one of the largest collections in the country of French Creole buildings from the late 18th and early 19th century and has retained several early buildings from the growing American population in the first two decades of the 1800s. The town's oldest buildings are recognized as National Historic Landmarks" (Missouri State Historic Preservation Office, 2011).

After the United States assumed control of the Missouri region following the Louisiana Purchase, architecture became more in line with an English building heritage. One room log structures with simple gabled roofs were built initially, while larger houses plans included Georgian cottages during the late 18th and early 19th centuries. I-houses were constructed during the 19th century, along with central passageway and hall and parlor houses. "The 'hall and parlor' variant, sometimes with a small foyer or hall between the two main rooms and typically built of frame, is one of the most familiar kinds of Missouri dwellings" (Marshall, 1994). "In the mid-19th century, many communities of German-speaking immigrants formed in the 'Rhineland' region of Missouri, generally south of the Missouri River, east of Jefferson City and along the Mississippi River north of Cape Girardeau. Some German-speaking farmers from Europe built in 'fachwerk' or half-timber construction traditions with the timbers joined with mortise-and-tenon techniques" (Marshall, 1994). Due to having some of the largest clay deposits in the country, Missouri became of the largest producers of structural brick among the states in the 19th century and brick was widely used in architectural construction in the state's cities and towns because of its affordability, durability, and fire resistance.

[125] See Section 10.1.7, Land Use, Recreation, and Airspace, for a more in-depth discussion of additional historic resources as they relate to recreational resources.

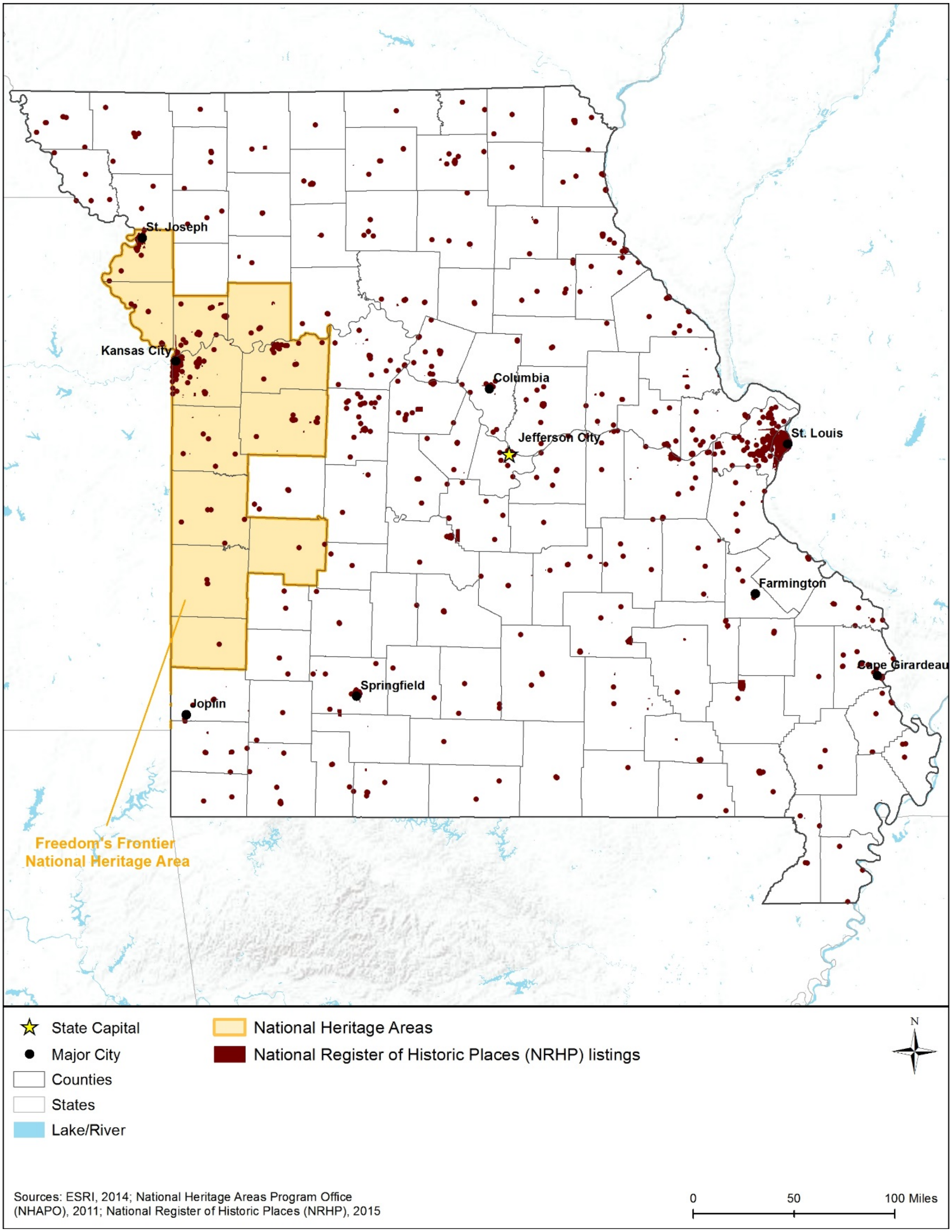

Figure 10.1.11-3: National Heritage Area (NHA) and National Register of Historic Places (NRHP) Sites in Missouri

Popular housing styles followed National trends, with Georgian architecture being popular during the late century and early 19th century. Federal architecture was popular during the first half of the 19th century, with Greek Revival coming into vogue during the second quarter of the 19th century and lasting through the conclusion of the Civil War (Marshall, 1994). Greek Revival examples include "National Register-listed properties such… (the) George A. Murrell House and outbuildings in Saline County, and Oakwood in Howard County" (Missouri State Historic Preservation Office, 2011).

Following the Civil War, Gothic Revival and Italianate were commonly built, with Italianate being common in both residential and commercial architecture during the latter part of the 19th century. Starting in the late 19th century, and moving into the early 20th century, revival styles like Mission Revival and Colonial Revival became common. Prairie architecture was popular until the 1920s, being influenced by Frank Lloyd Wright, with bungalows and minimal traditional houses then being built from prior to and after WWII respectively. Ranch houses were built following WWII, often in large suburban housing tracts outside of cities (McAlester, 2013).

Missouri has many important agricultural buildings, including farms houses, which would have taken one of the forms discussed above, as well as a variety of outbuildings and barns. Examples of slave quarters still exist as well, which are generally a rare and not well-preserved resource (Marshall, 1994). One of the ways that Missouri recognizes the importance of agricultural properties is through the "Century Farm" program, which recognizes the importance of farms that have been in the same family for over a century (University of Missouir Extension, 2015).

Early industrial buildings are important and can be found throughout the state, such as historic mill buildings. Grist mills were common and served as "the nucleus of thriving villages and towns as parts of Missouri were opened for settlement" (Old Mills of Missouri, 2015). As settlements progressed, institutional and civic buildings, such as churches, schools, and courthouses, were built, especially in Missouri's early urban areas (Missouri State Historic Preservation Office, 2011). Common church types include Gable End, Center-steeple, Side-steeple, Side-gable, Twin-tower, and others (National Register of Historic Places, 2010). Transportation resources have also historically been of importance to the state, with natural waterways providing the first means of transportation, navigated heavily by steamboats prior to the construction of the railroad. During the second half of the 19th century, railroad construction proliferated and became the dominant form of transportation. Many towns dating to this time were platted first as rail stops, and eventually grew into thriving communities. "New towns organized along the state's rail lines often had distinctive landscape features such as public squares or large lots adjacent to the freight depot to hold livestock for shipment to market" (Missouri State Historic Preservation Office, 2011).

Figure 10.1.11-4: Representative Architectural Styles of Missouri

- Top Left – Missouri State Capitol Building (Jefferson City, MO) – (Historic American Buildings Survey, 1933a)
- Top Right – Jean Baptiste Valle Barn (Ste. Genevieve, MO) – (Historic American Buildings Survey, 1933b)
- Bottom Left – Indian Trading Post (Ste. Genevieve, MO) – (Historic American Buildings Survey, 1933c)
- Bottom Middle – Oscar Deubbert Farm (Femme Osage, MO) – (Historic American Buildings Survey, 1933d)
- Bottom Right – Board of Trading Building (Kansas City, MO) – (Detroit Publishing Company, 1906)

10.1.12. Air Quality

10.1.12.1. *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 topography[126] 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)[127] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[128] This section discusses the existing air quality in Missouri. USEPA designates areas within the United States as attainment,[129] nonattainment,[130] maintenance,[131] or unclassifiable[132] depending on the concentration of air

[126] Topography: The unique features and shapes of the land (e.g., valleys and mountains).

[127] Equivalent to 1 milligram per liter (mg/L)

[128] 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, 2015n)

[129] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant. (USEPA, 2015o)

[130] 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, 2015o)

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 and Alternatives.

10.1.12.2. *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, oxides of nitrogen (NO_X), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_X). The NAAQS establish various standards, either primary[133] or secondary,[134] 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., three months or annual) are intended to prevent chronic health effects from long-term exposure. A description of the NAAQS is presented in Missouri Appendix E.

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). EPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs.

In addition to adopting the NAAQS, Missouri maintains additional air quality standards for hydrogen sulfide and sulfuric acid. Table 10.1.12-1 presents an overview of these additional Missouri Ambient Air Quality Standards as defined by the Missouri Department of Natural Resources (MDNR, 2015p).

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[131] 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, 2015o)

[132] 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, 2015o)

[133] 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, 2016d)

[134] 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, 2016d)

Table 10.1.12-1: Additional Missouri Ambient Air Quality Standards

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m³	ppm	µg/m³	ppm	
Hydrogen sulfide	½-hour	42	0.03	-	-	Not to be exceeded over 2 times in any 5 consecutive days
	½-hour	70	0.05	-	-	Not to be exceeded over 2 times per year
Sulfuric acid	1-hour	30	-	-	-	Not to be exceeded more than once in any 2 consecutive days
	24-hour	10	-	-	-	Not to be exceeded more than once in any 90 consecutive days

Source: (MDNR, 2015p)

Title V Operating Permits/State Operating Permits

Missouri 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, 2015g). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015g). Missouri Department of Natural Resources Air Conservation Commission describes the applicability of Title V operating permits in Chapter 6 of the Air Quality Standards and Regulations. Missouri 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 10.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014).

Table 10.1.12-2: Major Air Pollutant Source Thresholds

Any Criteria Pollutant[a]	100 Tons Per Year
Single Hazardous Air Pollutant (HAP)	10 Tons Per Year
Total/Cumulative HAPs	**25 Tons Per Year**

Source: (USEPA, 2016d)

[a] Sources in nonattainment areas will have lower thresholds for some criteria pollutants depending on the classification of the nonattainment area.

Exempt Activities

Missouri Rules 10 Code of State Regulations 10-6.061 identifies the following source categories as exempt from the requirement to obtain permits to construct:

- Combustion equipment:
  - Uses natural gas or liquefied petroleum gas and has a capacity of less than 10 million British Thermal Units (BTUs) per hour heat input.
  - Capacity of less than one million BTUs per hour heat input.
- "Equipment used for any mode of transportation (MDNR, 2015p).
- Specific internal combustion engines:
  - Portable electrical generators that do not require motorized or non-motorized vehicle, conveyance, or device for transport.

  - Spark ignition or diesel fired internal combustion engines used with pumps, compressors, pile drivers, welding, cranes, and wood chippers or internal combustion engines or gas turbines of less than 250 horsepower rating.
- "Internal combustion engines and gas turbine driven compressors, electric generator sets, and water pumps, used only for portable or emergency services, provided the maximum annual operating hours shall not exceed five hundred hours and… is equipped with a non-reset-table meter" (MDNR, 2015p).
- Sources that emit pollutants at or below the Insignificant Emission Exemption Levels specified in 10 CSR 10-0.061 (see Table 10.1.12-3).

Table 10.1.12-3: Insignificant Emission Exemption Levels

Pollutant	Insignificance Level (lbs per hr)
PM_{10} (emitted solely by equipment)	1.0
SO_x	2.75
NO_x	2.75
VOCs	2.75
CO	6.88

Source: (MDNR, 2015p).

Temporary Emissions Sources Permits

Missouri allows an installation owner or operator to "…apply for a single permit authorizing [major source] emissions from similar operations…at multiple, temporary locations" (MDNR, 2015p).

State Preconstruction Permits

Missouri requires installations that may emit at or greater than the de minimis[135] levels, shown in Table 10.1.12-4, for any pollutant to obtain construction permits per 10 CSR 10-6.060 (MDNR, 2015p).

Table 10.1.12-4: Missouri De Minimis Levels for Permit Applicability

Air Contaminant	Emission Rate (TPY)
CO	100.0
NO_X	40.0
Total PM	25.0
PM_{10}	15.0
$PM_{2.5}$	10.0
SO_2 ($PM_{2.5}$ precursor)	40.0
NO_X ($PM_{2.5}$ precursor)	40.0
SO_2	40.0
VOC (O_3 precursor)	40.0

[135]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, 2016g)

Air Contaminant	Emission Rate (TPY)
NO_X (O_3 precursor)	40.0
Lead	0.6
Fluorides (excluding hydrogen fluoride)	3.0
Hydrogen sulfide	10.0
Total reduced sulfur (including hydrogen sulfides)	10.0
Reduced sulfur compounds (including hydrogen sulfide)	10.0
Individual HAPs	10.0
All HAPs	25.0

Source: (MDNR, 2015p)

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, 2013a). A Proposed 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 Proposed Actions "in response to emergencies which are typically commenced on the order of hours or days after the emergency" and Proposed 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 (USGPO, 2010).

The estimated pollutant emissions are compared to de minimis levels. These values are the minimum thresholds for which a conformity determination must be performed (Table 10.1.12-5). As a result, lower de minimis thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

Table 10.1.12-5: General Conformity 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: (USGPO, 2010)

If a Proposed Action does not result in an emissions increase above the de minimis levels in Table 10.1.12-5, 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 10.1.12-5, then the Proposed Action must undergo a conformity determination. The federal agency must first show that the Proposed Action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity[136], 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 Proposed 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, 2010a).

[136] Conformity: Compliance with the State Implementation Plan.

State Implementation Plan Requirements

The Missouri SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Missouri's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Missouri's SIP actions are codified under 40 CFR Part 52 Subpart AA. A list of all SIP actions for all six criteria pollutants can be found on the Missouri Department of Natural Resources website (http://dnr.mo.gov/env/apcp/sips.htm).

10.1.12.3. *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. Figure 10.1.12-1 and Table 10.1.12-6, below, present the nonattainment areas in Missouri as of January 30, 2015. Table 10.1.12-6 contains a list of the counties and their respective current nonattainment state of each criteria pollutant. The year listed in the table for each pollutant indicate the date(s) when USEPA promulgated an ambient air quality standard for that pollutant; note that for $PM_{2.5}$, O_3, and SO_2, these standards listed are in effect. Unlike Table 10.1.12-6, Figure 10.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

Table 10.1.12-6: Missouri Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implanted Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Dent			X-6								
Franklin						X-4		M	X-5		
Iron		M	X-6								
Jackson											X-6
Jefferson		X-6	X-6			X-4		M	X-5		X-6
Reynolds			X-6								
St Charles						X-4		M	X-5		
St Louis	M					X-4		M	X-5		
St Louis Co	M					X-4		M	X-5		

Source: (USEPA, 2015h)

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

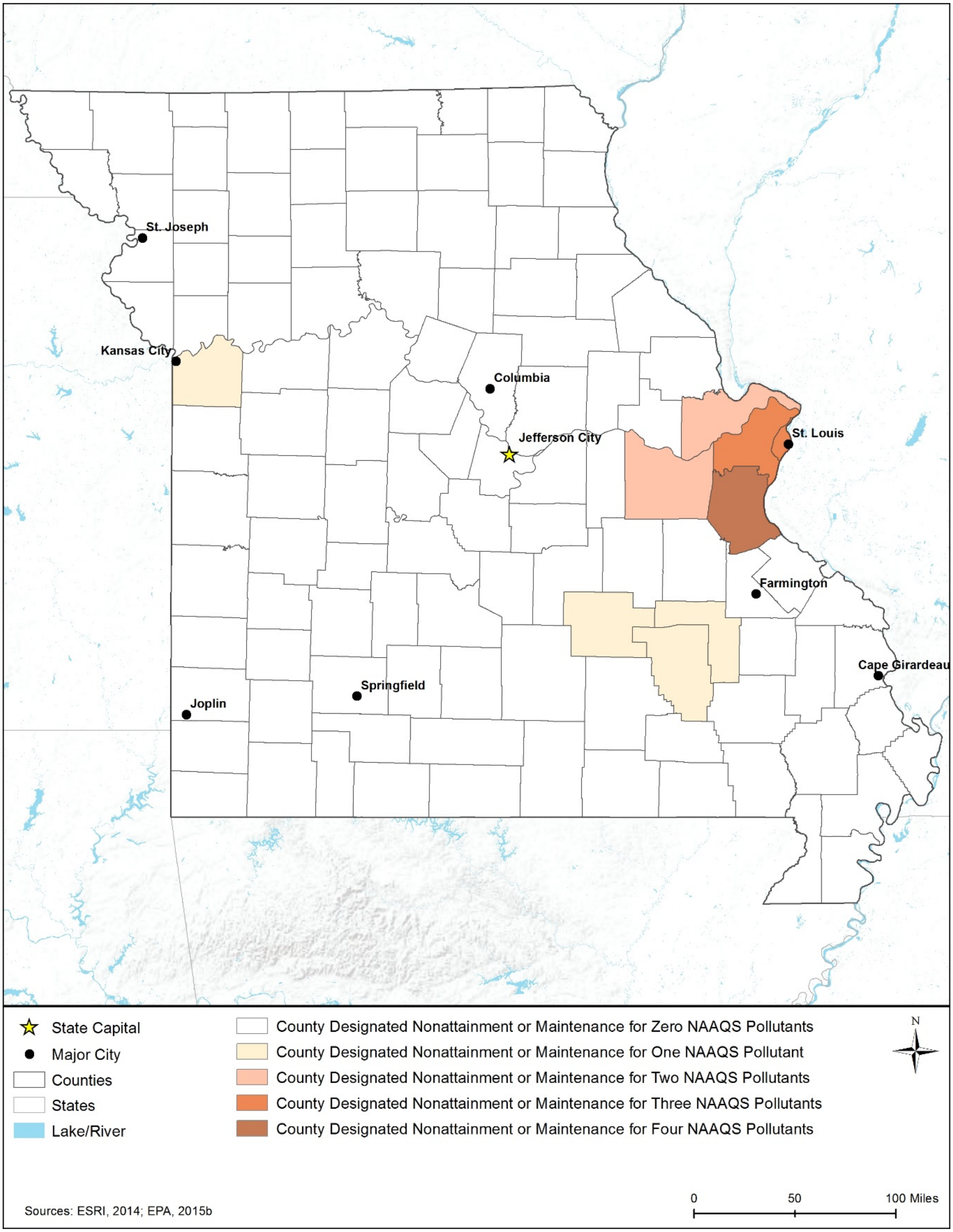

Figure 10.1.12-1: Nonattainment and Maintenance Counties in Missouri

Air Quality Monitoring and Reporting

The Missouri Department of Natural Resources measures air pollutants at 49 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Annual Missouri State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. The Missouri Department of Natural Resources updates pollution levels of ozone, lead, PM_{10}, $PM_{2.5}$, SO_2, CO and NO_2 on an hourly basis on their website, found at: http://dnr.mo.gov/env/esp/aqm/allguide.htm.

As of the end of October 2015, O_3 and SO_2 measurements exceeded the federal standard of 0.075 ppm two times at sites in St. Charles and Perry County, and 34 times in Jackson County, respectively. During this same timeframe, $PM_{2.5}$ measurements exceeded the federal standard of 12 $\mu g/m^3$ 1,147 times at several sites across Missouri. No other criteria pollutants exceed federal or state standards.

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, 2012a) 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 kilometers[137] of a Class I area. "The EPA's policy is that FLMs should be notified by the Regional Office about any Proposed Action 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.
- 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

[137] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

beyond the point of significant impact or the source or 50 kilometers[138] (the normal useful range of EPA-approved Gaussian plume models" (USEPA, 1992).

- Missouri contains two Federal Class I areas. All other land within the state is classified as Class II (USEPA, 2016e). 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 (USEPA, 1992). Arkansas also has a Class I area where the 100-kilometer buffer intersects a few Missouri counties. Any PSD-applicable Proposed Action within these counties would require FLMs notification from the appropriate Regional Office. Figure 10.1.12-2 provides a map of Missouri 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 10.1.12-2 correspond to the numbers and Class I areas listed in Table 10.1.12-7.

Table 10.1.12-7: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Mingo Wilderness	8,000	MO
2	Hercules-Glades Wilderness	12,315	MO
3	Upper Buffalo Wilderness	9,912	AR

Source: (USEPA, 2016e)

[a] The numbers correspond to the shaded regions in Figure 10.1.12-2.

[138] The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

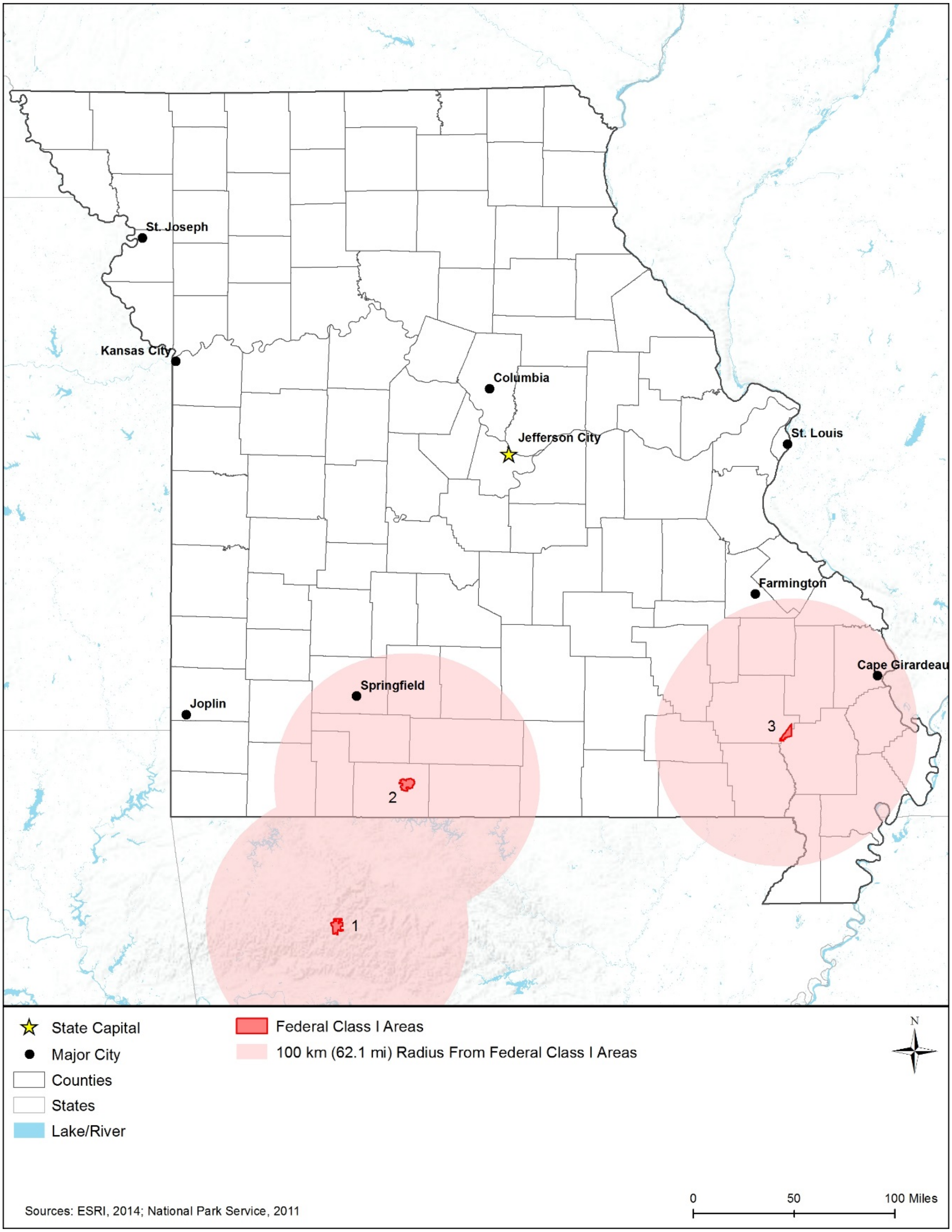

Figure 10.1.12-2: Federal Class I Areas with Implications for Missouri

10.1.13. Noise

This section presents a discussion of a basic understanding of environmental noise, background/ambient noise levels, noise standards, and guidelines.

10.1.13.1. *Definition of the Resource*

Noise is a form of sound 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.

Fundamentals of Noise

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. 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 (USDOT 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 (SPL) (the frequency characteristics and SPL 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 10.1.13-1 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.

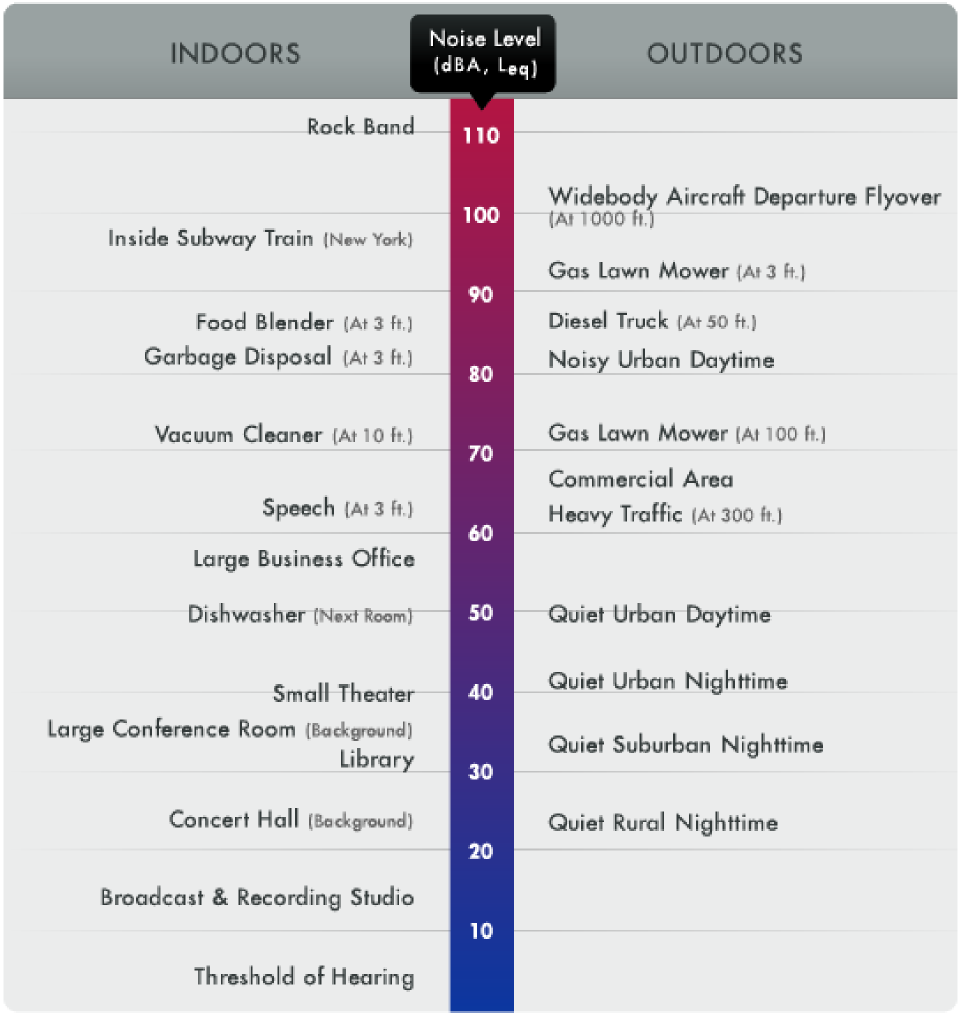

Figure 10.1.13-1: Sound Levels of Typical Sounds

Leq: Equivalent Continuous Sound Level
Source: (Sacramento County Airport System, 2015)
Prepared by: Booz Allen Hamilton

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 (for example: 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (for example: 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (USDOT 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, 1973a). Ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

10.1.13.2. *Specific Regulatory Considerations*

As identified in Appendix E, 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, 1973b). Similarly, most states have no quantitative noise-limit regulations.

Missouri has several statewide noise regulations written into its general and permanent law, which are compiled under the Missouri Revised Statutes. They mainly apply to motor vehicle functions such as engine running and horns. Table 10.1.13-1 provides a brief summary of these regulations.

Table 10.1.13-1: Relevant Missouri Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
MRS, Section 305.630	MDOT	Establishes maximum noise levels for airports.
MRS, Section 307.170	MDOT	Requires motor vehicles to use a horn and muffler.

Source: (Missouri Legislature, 2015b)

Many cities and towns may have additional, local noise ordinances to further 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 St. Louis, Kansas City, and Springfield are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (USDOT FHWA, 2011).

10.1.13.3. *Environmental Setting: Ambient Noise*

The range and level of ambient noise in Missouri varies widely based on the area and environment of the area. The population of Missouri can choose to live and interact in areas that are large cities, rural or suburban communities, small towns, and national and state parks. Figure 10.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Missouri may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Missouri. As such, this section describes the areas where the population of Missouri 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 urban areas that are likely to have the highest ambient noise levels in the state are St. Louis, Kansas City, and Springfield as these are larger metropolitan centers with larger populations.
- **Airports:** Areas surrounding airports tend to have higher noise levels 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 is in proximity to urban communities resulting in noise exposures from aircraft operations (arrivals/departures) to surrounding areas at higher levels and 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 Missouri, Lambert-St. Louis International Airport (STL) and Kansas City International Airport (MCI) have combined annual operations of more than 310,000 flights (FAA, 2015i). These operations result in increased ambient noise levels in the surrounding communities. See Section 10.1.7, Land Use, Recreation, and Airspace and Table 10.1.7-6 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 (USDOT FHWA, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (USDOT FHWA, 2015d). See Section 10.1.1, Infrastructure and Figure 10.1.1-1 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 (USDOT 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 when approaching a crossing (USDOT FRA, 2015). Missouri has several rail corridors with passenger traffic. The Missouri River Runner route runs between St. Louis and Kansas City, with stops in Kirkwood, Washington, Hermann, Jefferson City, Sedalia, Warrensburg, Lee's Summit, and Independence. The Missouri section of the Southwest Chief route stops at La Plata and Kansas City. The Missouri section of the Texas Eagle route stops at St. Louis and Poplar Bluff (MoDOT, 2008). See Section 10.1.1, Infrastructure, and Figure 10.1.1-1 for more information about rail corridors in the state.
- **National and State Parks:** National and state parks situated in wilderness areas are likely to have lower than average ambient noise levels given their size and location. Parks located in

urban areas are likely to have higher noise areas reflective of their location. National and state parks, historic areas, memorials, and monuments are protected areas to preserve these areas in their natural environment. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014g). Missouri has six national parks and 16 National Natural Landmarks (NPS, 2015c). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 10.1.8, Visual Resources and Figure 10.1.8-1 for more information about national and state parks for Missouri.

10.1.13.4. *Sensitive Noise Receptors*

Noise-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 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 levels in remote wilderness and rural nighttime areas are usually 30 dBA (BLM, 2014). Most cities, towns, and villages in Missouri have at least one school, church, or park, in addition to likely having other noise-sensitive receptors. There are most likely thousands of sensitive receptors throughout the state of Missouri.

10.1.14. Climate Change

10.1.14.1. *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 (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e), which equalizes for the different global warming potential of each type of GHG.[139] Where this document references emissions of CO_2 only, the units are in million metric tons MMT CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" with "Atmospheric concentrations of CO_2 increased from 280 parts per million

[139] CO_2e 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 (MMTCO_2e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMTCO_2E = (million metric tons of a gas) * (GWP of the gas.)" (USEPA 2015)

(ppm) of carbon in 1750 to 379 ppm of carbon in 2005" (IPCC, 2007). The atmospheric concentration of CH_4 and N_2O 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 potential climate change effects on the Proposed Action and Alternatives, are considered in this PEIS (see Section 10.2, Environmental Consequences). Existing climate conditions in the Proposed Action area 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: 1) temperature; 2) precipitation / drought; and 3) severe weather events.

10.1.14.2. *Specific Regulatory Concerns*

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix E. Missouri has not established goals and regulations to reduce GHG emissions to help combat climate change.

10.1.14.3. *Greenhouse Gas Emissions*

Estimates of Missouri 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 CH_4 and nitrous oxide (NO_x), but not at the state level (EIA, 2015d). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015i). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

For the purposes of this PEIS, the EIA data on CO_2 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 CH_4, the source is described and cited.

According to the EIA, Missouri emitted a total of 131.3 MMT of CO_2 in 2013. CO_2 emissions were dominated by the electric power sector, mostly from coal (Table 10.1.14-1) (EIA, 2015e). Annual emissions between 1980 and 2013 are represented in Figure 10.1.14-1. Missouri's CO_2 emissions increased in all areas and all fuel types between 1980 until a maximum of 141.3 MMT in 2005, at which point they began to decline from all fuel types and sources. Like many states, Missouri's CO_2 emissions increased slightly in 2013 (EIA, 2015e). Missouri was ranked 13th in the U.S. for total CO_2 emissions in 2013, and 18th overall for per capita CO_2 emissions (EIA, 2015h).

Table 10.1.14-1: Missouri CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	76.2	Residential	6.7
Petroleum Products	40.2	Commercial	4.3
Natural Gas	14.9	Industrial	9.1
		Transportation	35.4
		Electric Power	75.8
TOTAL	**131.3**	**TOTAL**	**131.3**

Source: (EIA, 2015e)

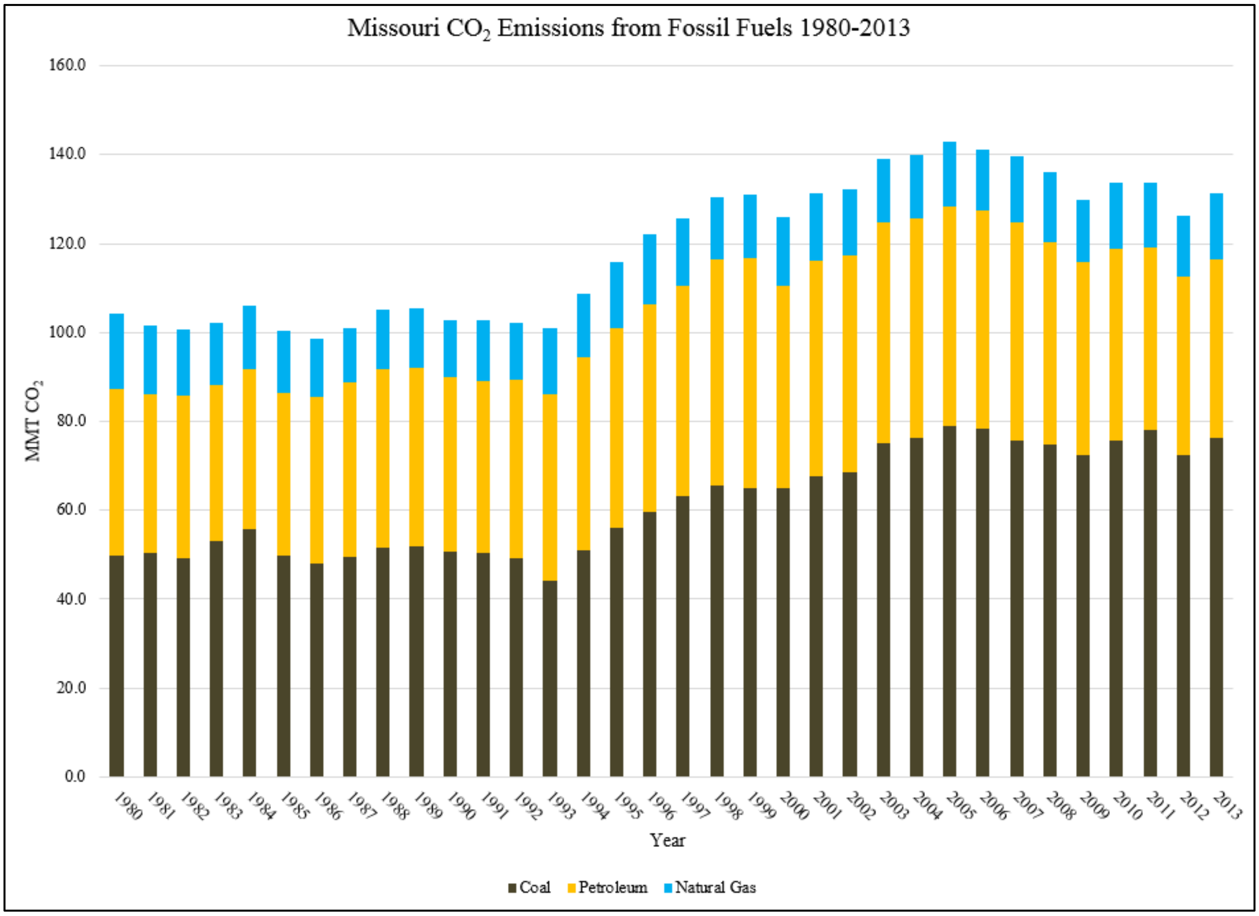

Figure 10.1.14-1: Missouri CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015e)

The majority of Missouri's GHG emissions are CO_2. These emissions are the result of fossil fuel combustion for the purpose of producing energy, mostly petroleum products from electric power generating facilities and coal-fired power plants. Other major GHGs emitted in Missouri are

CH_4, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF_6) and perfluorocarbons, mostly released during the course of industrial activities. (USEPA, 2015j)

The Missouri Department of Natural Resources Division of Energy prepared a 1990 - 2015 GHG inventory and projections for the state in 1999 (MDNR, 1999). The report estimated total GHG emissions in 1990 at 148 million short tons (134 MMT) CO2e, of which 123 million short tons (112 MMT) was CO_2 and 25 million short tons (22 MMT) CO_2e was other gases such as CH_4, NO_x, and PFCs. Projections estimated future total GHG emissions in 2015 to be 164-165 million short tons (149-150 MMT) CO_2e for a low-emissions scenario, 171 to174 million short tons (155-158) MMT CO_2e for the mid-range emissions scenario, and 180 million short tons (163 MMT) CO_2e for the high emissions scenario (MDNR, 1999). For comparison, total U.S. GHG emissions were 6,673 MMT CO_2e (14.7 trillion pounds) in 2013 (USEPA, 2015j).

Petroleum production in Missouri began after the Civil War and peaked in the 1980s. Because oil prices have risen in the last few years, Missouri increased oil production rates which resulted in emissions growth. Missouri is not a large petroleum producer or refiner which results in their emission being lower than that of other states. Missouri primarily receives petroleum from the Gulf Coast by pipelines that pass through the state. Petroleum related emissions will likely rise in the next few years due to potential oil sources in western Missouri (MDNR, 1999) (EIA, 2015f).

Petroleum grew in all sectors between 1990 and 1996 however, emissions from the transportation sector had the most significant increase. Missouri is a transportation hub for North America, therefore the transportation sector is often the largest GHG contributor. “Missouri's infrastructure and location give shippers the ability to move raw materials and finished products quickly and economically by rail, river, and truck.” (EIA, 2015f) As the population and economy continues to grow, it is likely that emissions from this sector will continue to rise (MDNR, 1999) (EIA, 2015f).

The primary resource used for electricity generation in Missouri is coal however, the state does not produce enough to meet the states’ demands and instead receives coal by rail and truck from Wyoming and Illinois. Four-fifths of electricity come from the state’s 10 coal fired power plants. The remainder of the electricity is supplied by a nuclear power plant and a natural gas-fired power plant, hydroelectricity and wind turbines (EIA, 2015f).

10.1.14.4. *Environmental Setting: Existing Climate*

The National Weather Service defines climate as the “reoccurring average weather found in any particular place” (NWS, 2011a). 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, 2011a). 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 characteristics (NWS, 2011a).

The majority of Missouri is classified within the climate classification group C. Climates classified as C are generally warm, with humid summers and mild winters. During winter months, the mean climate feature is the mid-latitude cyclone (NWS, 2011a). Although the majority of the state is classified within the climate group C, northern regions of the state are within the climate group D. Climates classified as D are "moist continental mid-latitudinal climates," with "warm to cool summers and cold winters" (NWS, 2011a). In (D) climates, the "average temperature of the warmest month is greater than 50 degrees Fahrenheit (°F), while the coldest month is less than negative 22 °F" (NWS, 2011a). Winter months in D climate zones are cold and severe with "snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses" (NWS, 2011a). Thunderstorms are also common during summer months. Missouri has two sub-climate categories described in the following paragraphs.

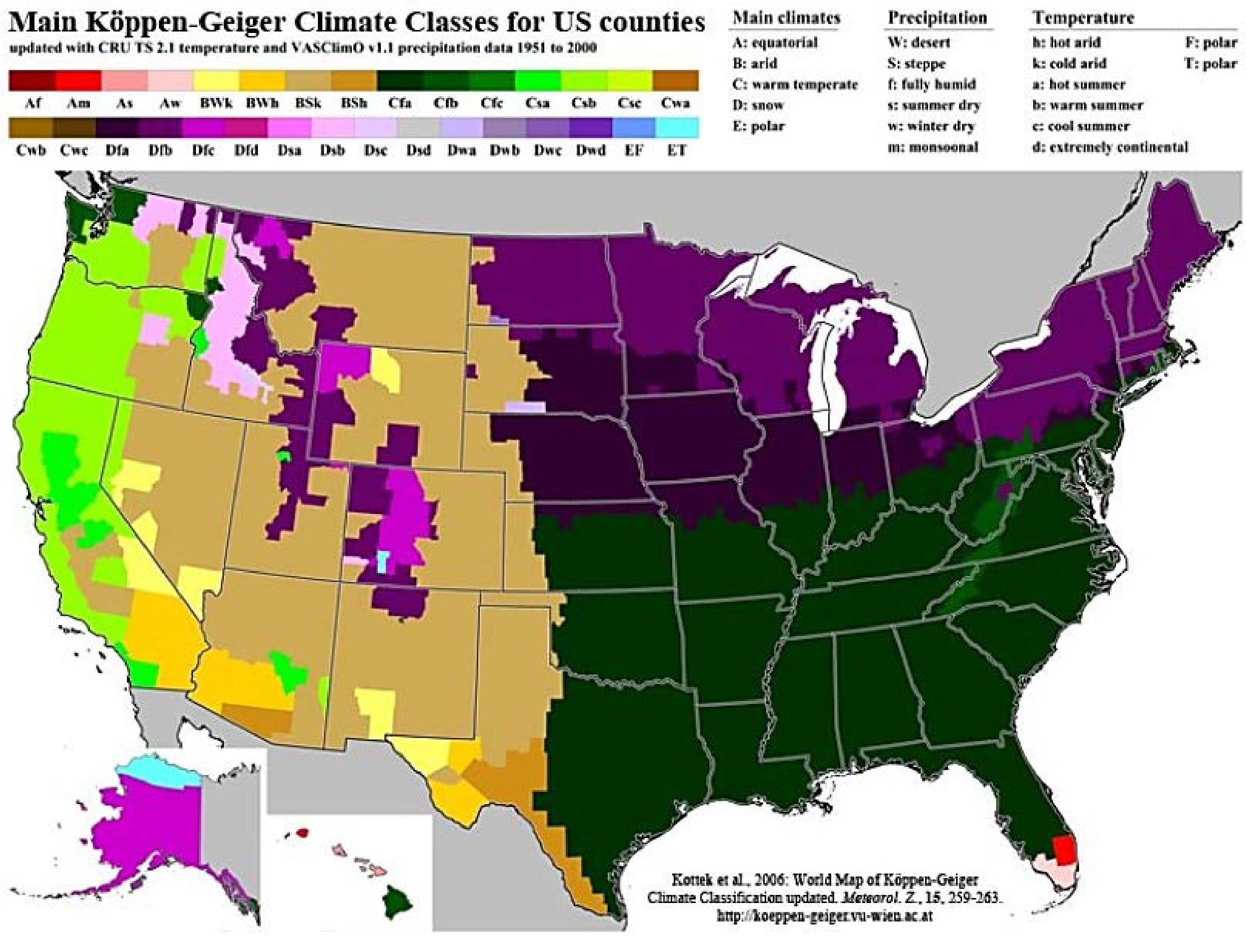

Figure 10.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

The Köppen-Geiger climate classification system classifies the majority of Missouri 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, 2011a) (NWS, 2011b).

The Köppen-Geiger climate classification system classifies the remainder of Missouri, the northern regions, as Dfa. Climates classified as Dfa are characterized by warm and humid temperatures, with hot summers and precipitation occurring regularly throughout the year. In this climate classification zone, the secondary classification indicates substantial precipitation during all seasons. In this climate classification zone, the tertiary classification indicates hot summer months, with warmer temperatures averaging above 71.6 °F (NWS, 2011a) (NWS, 2011b).

Air Temperature

The climate of Missouri is continental, with strong seasonality. The average annual temperature (1895 to 2014) in Missouri is approximately 54.6 °F (Missouri Climate Center, 2015a). During winter months, the average annual temperature is approximately 32.1 °F (Missouri Climate Center, 2015a). During summer months, the average annual temperature is approximately 75.6 °F (Missouri Climate Center, 2015a). During winter months, cold and dry air masses periodically move south into the state from Canada, "unchallenged by any topographical barriers" (Decker, 2015). During winter months, warm air from the Gulf of Mexico extends north. Spring and autumn months are "transitional seasons when abrupt changes in temperature and precipitation may occur due to successive, fast-moving fronts separating contrasting air masses" (Decker, 2015).

Cfa – Jefferson City, the capital of Missouri, is located within central Missouri and within the climate classification zone Cfa. The average temperature in Jefferson City is approximately 56.0 °F; 34.3 °F during winter months; 76.4 °F during summer months; 55.7 °F during spring months; and 57.1 °F during autumn months (NOAA, 2015b). Kansas City, located in northwestern Missouri, is also within the climate classification zone Cfa. The average temperature in Kansas City is approximately 54.6 °F; 31.2 °F during winter months; 76.4 °F during summer months; 54.5 °F during spring months; and 56.1 °F during autumn months (NOAA, 2015b).

Dfa – Maryville, located in far northwestern Missouri, is within the climate classification zone Dfa. The average temperature in Maryville is approximately 51.3 °F; 26.7 °F during winter months; 74.0 °F during summer months; 51.2 °F during spring months; and 53.0 °F during autumn months (NOAA, 2015b). Hannibal, located in northeastern Missouri, is also within the climate classification zone Dfa. The average temperature in Hannibal is 52.8 °F; 28.7 °F during winter months; 74.5 °F during summer months; 52.7 °F during spring months; and 54.8 °F during autumn months (NOAA, 2015b).

Precipitation

Average precipitation throughout Missouri is highly variable, ranging from a low of 34 inches in the northwest, to a high of 50 inches in the southeast. June is northwestern Missouri's wettest month, receiving an average of five times more precipitation than Missouri's driest month, January. In southeastern Missouri, "seasonality in precipitation is insignificant due to the greater influence of subtropical air masses throughout the year" (Decker, 2015). The greatest 24-hour precipitation accumulation was on July 20, 1965 with a total of 18.18 inches in Edgerton (SCEC, 2015) (Decker, 2015).

Snowfall in Missouri can begin as early as October and end as late as May. However, the majority of snowfall statewide falls during December, January, and February. Northern Missouri receives the most snowfall, with an average between 18 and 24 inches each year. In southern areas of the state, the average drops to approximately 8 to 12 inches. Precipitation during winter months is generally in the form of snowfall, with an occasional mix of snow, rain, or ice. The greatest 24-hour snowfall accumulation was on February 25, 1979 with a total of 24 inches (SCEC, 2015) (Decker, 2015).

Precipitation during spring, summer, and autumn is generally due to thunderstorms. Thunderstorms in Missouri are most frequent between April and July. Hail also occurs throughout the state and throughout the year, but is least likely during winter months. May commonly experiences the greatest number of days with hail. Measureable precipitation in Missouri occurs an average of 100 days per year, with approximately half of these days due to thunderstorms (Decker, 2015).

Cfa – Jefferson City, the capital of Missouri, is located within central Missouri and within the climate classification zone Cfa. The average annual predication accumulation in Jefferson City is 43.96 inches; 6.90 inches during winter months; 13.10 inches during summer months; 12.31 inches during spring months; and 11.65 inches during autumn months (NOAA, 2015b).

Dfa – Maryville, located in far northwestern Missouri, is within the climate classification zone Dfa. The average annual precipitation accumulation in Maryville is 37.25 inches; 3.39 inches during winter months; 14.14 inches during summer months; 11.11 inches during spring months; and 8.61 inches during autumn months (NOAA, 2015b). Hannibal, located in northeastern Missouri, is also within the climate classification zone Dfa. The average annual precipitation accumulation in Hannibal is 41.39 inches; 6.61 inches during winter months; 12.90 inches during summer months; 11.71 inches during spring months; and 10.17 inches during autumn months (NOAA, 2015b).

Severe Weather Events

Statewide, Missouri experiences extreme and sometimes severe precipitation climate events. "Among these extreme climatic events are high-intensity rains, ice storms, and blizzards" (Decker, 2015). These events can, in turn, "lead to other environmental disturbances such as floods, landslides, and abrupt changes in plant and animal populations and distributions" (Decker, 2015).

High-intensity precipitation is also characteristic of Missouri. "The town of Holt in northwestern Missouri holds the world record for a high-intensity rain, having received 12 inches within a 42-minute period on June 22, 1947" (Decker, 2015). Historically and statistically, a precipitation event producing at least 4.5 inches of rainfall within a 24-hour period occurs at least once every two years (Decker, 2015).

Tributary and flash floods are also common to Missouri, with most floods occurring due to heavy rainfall or thunderstorms. The majority of tributary or flash flooding events occur during spring and summer months, between April and July. "Serious flooding occurs less frequently along the main stems of the Missouri and Mississippi Rivers and usually occurs during the spring and early summer" (Decker, 2015). "Main stem flooding may be caused by prolonged period of heavy rains, ice jams, or upstream flood crests synchronized with heavy tributary discharge" (Decker, 2015). Total rainfall across the state varies from "nearly 600 million gallons in the northwest corner, to over 800 million gallons in the southeast" (Decker, 2015). The wettest year in Missouri history was in 2008, with a statewide average of 57.34 inches. The driest year in Missouri history was in 1953, with a statewide average of 25.35 inches (Decker, 2015).

One of the most expensive floods in U.S. history occurred along the Missouri and Mississippi Rivers in 1993. During the first seven months of 1993, there was more than 50 inches of rainfall, double the usual amount. In June and July, severe thunderstorms further intensified rainfall along much of the lower Missouri and middle Mississippi River basins. Throughout the Midwest, "at least 75 towns were completed inundated, an estimated 54,000 people were evacuated, and above 50,000 homes were damaged or destroyed by the flooding" (NWS, 2015b). Monetary losses totaled over $15 billion in damages and there were 50 deaths, 13 of which took place in Missouri. More recently in 2011, record snowmelt in the upper Mississippi River basin and Ohio River led to severe flooding in southeastern and south central Missouri, causing over $320 million in damages (NWS, 2015b).

Located within the central U.S., Missouri commonly experiences a clash of air masses, particularly during April and May. Severe thunderstorms are also common during these months, which can lead to tornadoes throughout the state. On average, Missouri experiences 30 tornadoes a year, with the majority occurring between April and May. In 2010, Missouri recorded 65 tornadoes, the eighth highest totals since 1950. One of the worst tornadoes in U.S. history occurred on May 23, 2011 in Joplin. Peak winds during this tornado reached over 200 miles per hour (mph), destroyed the Missouri town, killed 162 people, and caused over $2.8 billion in monetary damages. In total, 17,000 people were affected. During another deadly storm event, a tornado struck St. Louis on May 27, 1896. This storm killed 255 people and caused $2.54 billion in damages. Prior to the tornado that struck Joplin, this was the most costly tornado to touch down in Missouri (Missouri Climate Center, 2015b) (U.S. News, 2013).

10.1.15. Human Health and Safety

10.1.15.1. *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 general 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 (RF) radiation or vehicle traffic. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 10.1.1, Infrastructure.

10.1.15.2. *Specific Regulatory Considerations*

Federal organizations, such as OSHA, USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Missouri, this resource area is regulated by the Missouri Department of Labor (MDOL), and the Missouri Department of Natural Resources (MDNR), Division of Environmental Quality (MDEQ) regulates waste and environmental pollution. Health and safety of the general public is regulated by the Missouri Department of Health and Senior Services (MDHSS). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Missouri does not have an OSHA-approved “State Plan.” Therefore, public and private sector occupational safety and health programs in Missouri are enforced by OSHA.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations. Table 10.1.15-1 below summarizes the major Missouri laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 10.1.15-1: Relevant Missouri Human Health and Safety Laws and Regulations

State Law / Regulation	Regulatory Agency	Applicability
MSR: Title 10, Division 45	MDNR	Provides technical guidelines for groundwater protection plans, mineral waste management structures, and reclamation and reuse.
MSR: Title 10, Division 25, Chapter 15	MDNR	Describes eligibility requirements for inclusion into the Voluntary Cleanup Program (VCP), as well as program stipulations.
MRS, Chapter 292	Missouri Department of Labor (MDOL)	Describes state rules regarding occupational safety and hazardous substances.
MSR: Title 19, Division 20	Missouri Department of Health and Senior Services (MDHSS)	Contains regulations relating to public health about toxic substances, lead, and emergency response.

10.1.15.3. *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 in 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. 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, 2015a). 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 manholes[140] are examples of when trenching or confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width) would occur. Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics.

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.

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.

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

[140] 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.

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 a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 10.1.13, 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.

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 use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., 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 general 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.

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under wetlands and waterways, including lakes, rivers, ponds, and streams. Workers responsible for these activities may 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.

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.

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, Bureau of Labor Statistics (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 one of 840 occupations. Telecommunications occupations are identified as both 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 5,160 telecommunication equipment installers and repairers, and 1,820 telecommunication line installers and repairers (Figure 10.1.15-1) working in Missouri (BLS, 2015c). In 2013, the most recent year data are available, Missouri reported 2.0 cases of nonfatal injuries in the telecommunications industry (BLS, 2013a). By comparison, there were 2.2 nonfatal occupational injury cases nationwide in 2014 per 100 full-time workers in the telecommunications industry (BLS, 2015d).

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 total occupational fatalities (4,585 total). Missouri had one fatality within the telecommunication equipment installers and repairers occupation (SOC code 49-2022) in 2012. By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-0000), Missouri had 106 fatalities between 2003 and 2014, with the highest fatality year being 14 fatalities in 2008 (BLS, 2015e).

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites, due to limited access. MDHSS collects injury surveillance and fatality data among the general public through the Missouri Environmental Public Health Tracking (EPHT) website. While the EPHT website cannot be searched for cases specific to telecommunication sites, the site provides documents regarding occupational health. Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards. The same data are reported with more specificity at the federal level through the Center 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 159 fatalities due to a fall from, out of, or through a building or structure; 33 fatalities due to exposure to electric transmission lines; and 40 fatality due to being caught, crushed, jammed or pinched in or between objects (Centers for Disease Control and Prevention, 2015a).

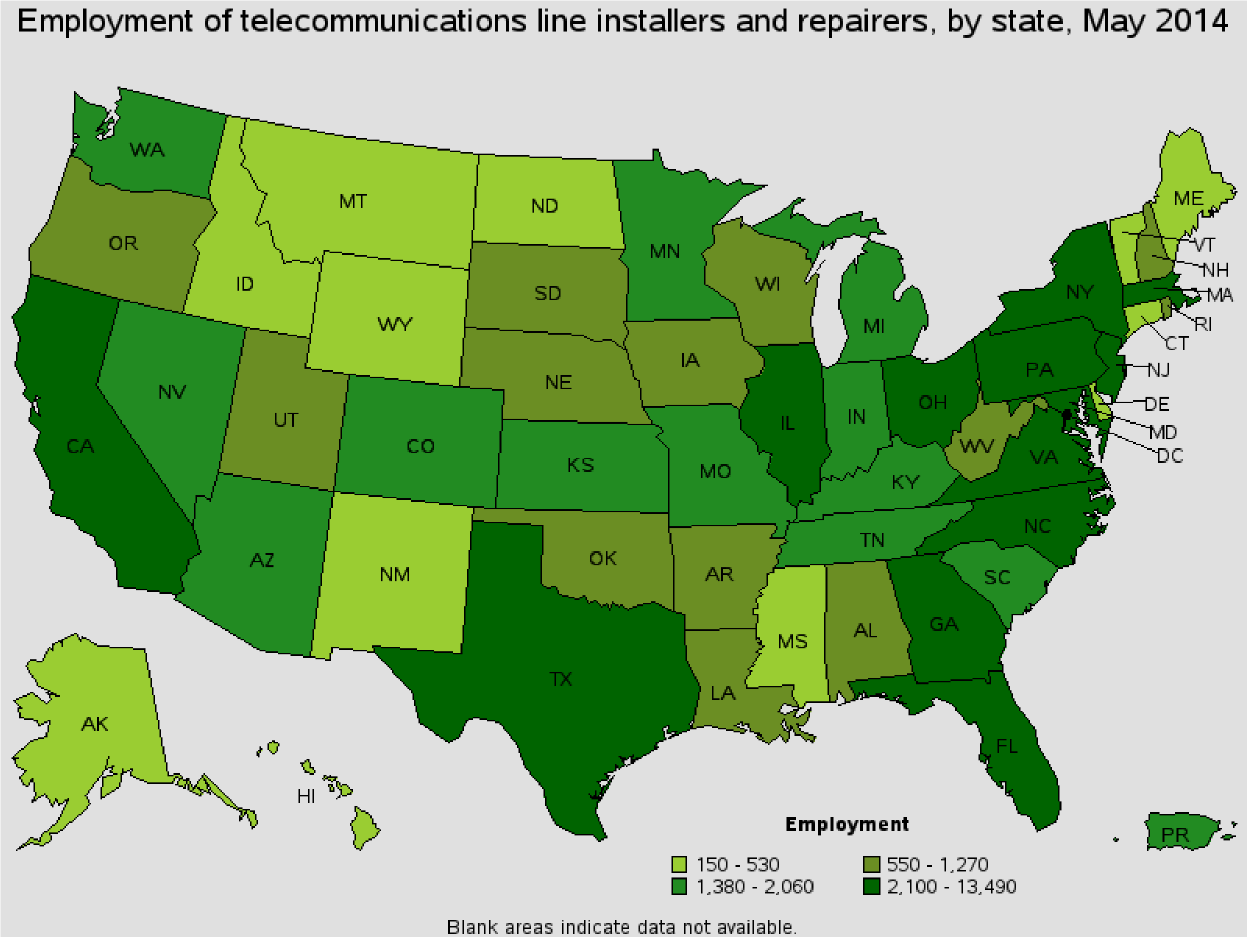

Figure 10.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (Bureau of Labor Statistics, 2015a)

10.1.15.4. *Environmental Setting: 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.

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[141] or listed on the National Priorities List (NPL), as well as the Resource Conservation

[141] 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)

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 Missouri, MDNR provides oversight to USEPA superfund sites in the state. The MDNR, Superfund Section responds to releases of hazardous materials, using funding from the state Hazardous Waste Remedial Fund (MDNR, 2015q). As of September 2015, Missouri had 69 RCRA Corrective Action sites[142], 1,234 brownfields, and 34 proposed or final Superfund/NPL sites (USEPA, 2015q). Based on a September 2015 search of USEPA's Cleanups in My Community (CIMC) database, there are nine Superfund sites in Missouri where contamination has been detected at an unsafe level, or a reasonable human exposure risk exists (Big River Mine Tailings/St. Joe Minerals Corp. near Desloge, MO; Anschutz – Madison Mine near Fredericktown, MO; Newton County Mine Tailings near Granby, MO; Oronogo-Duenweg Mining Belt near Jasper, MO; Southwest Jefferson County Mining in Jefferson County, MO; and multiple Washington County Lead District sites near Caledonia, Old Mines, Potosi, and Richwoods, MO) (USEPA, 2015r).

MDNR also oversees brownfield cleanup and redevelopment through the Voluntary Cleanup Program (MDNR, 2015r). One example of a brownfield site is the Botanical Heights Neighborhood Playgrounds, which was constructed on the site of a former filling station and auto repair facility with funding from a $960,000 grant made to the Saint Louis Development Corporation. Petroleum-impacted soils and several Underground Storage Tanks (USTs) associated with the former filling station were removed from the site before the playground was constructed (St. Louis Development Corporation, 2011).

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 (EPCRA) of 1986. The Toxics 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 to 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 September 2015, Missouri had 526 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

[142] Data gathered using the USEPA's Cleanups in My Community (CIMC) search on November 4, 2015, for all sites in Missouri, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active).

to the USEPA, in 2013, the most recent data available, Missouri released 71.9M pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the metal mining industry. This accounted for 1.75 percent of nationwide TRI releases, ranking Missouri 20 of 56 U.S. states and territories based on total releases per square mile (USEPA, 2015s).

Another USEPA program is the National Pollutant Discharge Elimination System (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, Missouri had 181 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015t).

The National Institute 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" (NIH, 2015a). Figure 10.1.15-2 provides an overview of potentially hazardous sites in Missouri.

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, there are 44 USEPA-regulated telecommunications sites in Missouri (USEPA, 2015u). Sites such as this are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Missouri had 14 fatalities between 2003 and 2014 in the installation, maintenance, and repair occupations from exposure to "harmful substances or environments," although these were not specific to telecommunications (BLS, 2015e). 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, 2015f). In 2014, BLS also reported four fatalities[143] 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).

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 general

[143] BLS Census of Fatal Occupational Injuries data for 2014 is for preliminary reporting only. Final data is expected to be released in spring 2016. (BLS, 2015g)

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.

The MDHSS is responsible for collecting public health data resulting from exposure to environmental contamination, and provides publicly available health assessments and consultations for documented hazardous waste sites (Missouri Department of Health and Senior Services, 2015). At the federal level, the Center 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. In 2005, the most recent year data are available, Missouri reported a rate of two injuries and fatalities due to reported acute toxic substance release incidents per 100,000 population (Centers for Disease Control and Prevention, 2015b).

10.1.15.5. *Environmental Setting: Abandoned Mine Lands at or near Telecommunications Sites*

Another health and safety hazard in Missouri includes surface and subterranean mines. In 2015, the Missouri mining industry ranked 11th for nonfuel minerals (crushed stone, Portland cement, sand, lead, and lime), generating a value of $2.56B (USGS, 2016a). That same year, Missouri had only one surface coalmining operation, employing 24 workers (EIA, 2013). 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 (BLM, 2015).

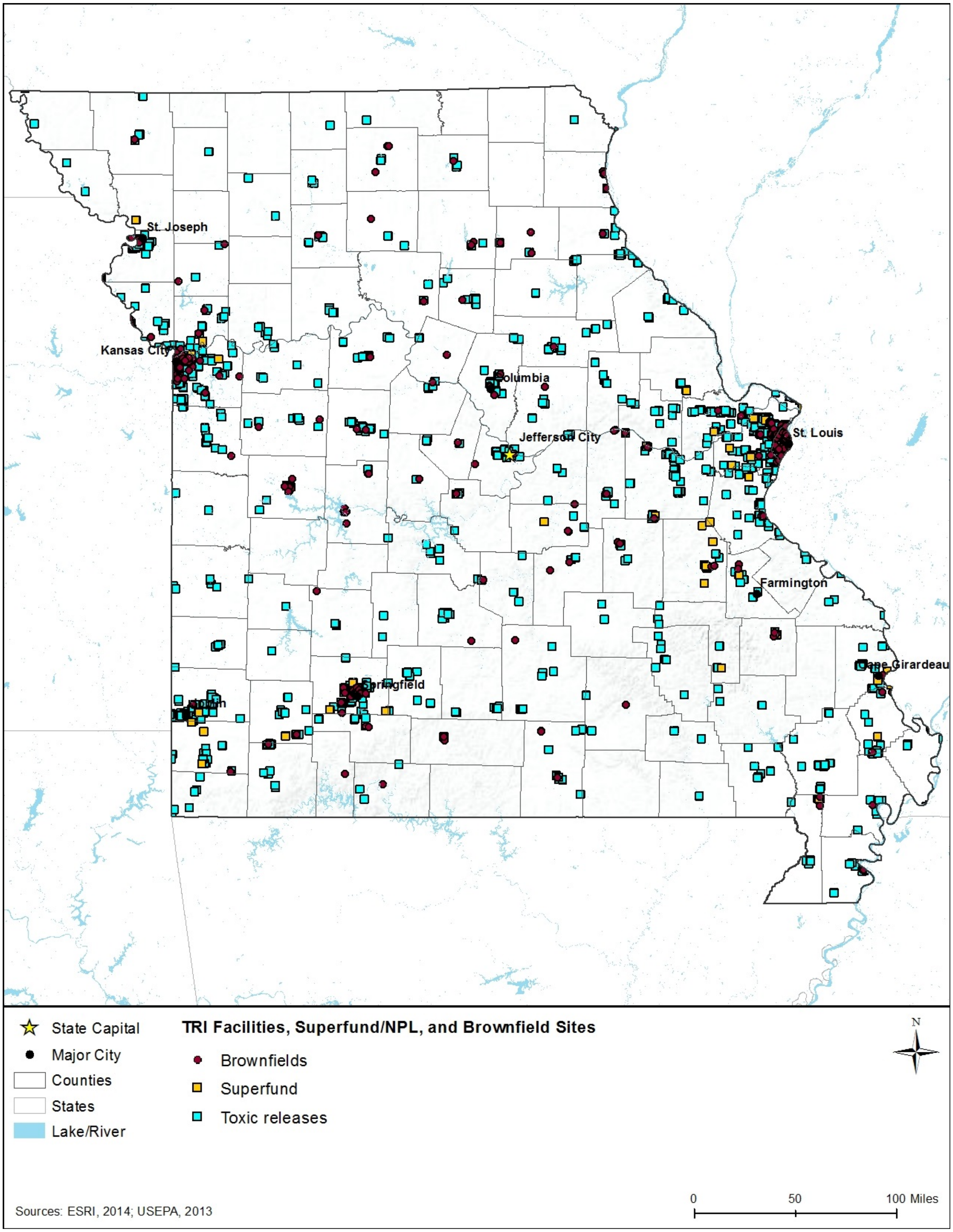

Figure 10.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Missouri (2013)

Source: (NIH, 2015b)

Spotlight on Missouri Superfund Sites: Washington County Lead District

The Washington County Lead District in Washington County, MO, includes four active Superfund sites in or near Caledonia, Old Mines, Potosi, and Richwoods, MO. The Richwoods Site, a large portion of the Washington County Lead District, includes about 45 square-miles in the northeast corner of Washington County. Widespread surface mining for galena, the mineral from which lead is refined, began in the early 1700s and continued into the 1980s. As a result, many abandoned strip mines, shafts, waste rock piles, tailing areas and ponds exist in the area (Figure 10.1.15-3) (USEPA, 2010b). Exposure risks at these sites include lead-contaminated wastes from the mining, milling, and smelting of lead-containing minerals. These wastes were typically deposited on the surface, and leached into the groundwater or dispersed in the wind, affecting large areas (Agency for Toxic Substance and Disease Registry, 2010).

In 2007, the USEPA tested 346 residential properties near the Richwoods, MO, site, and identified 65 residential properties and a schoolyard that exceeded standards for lead contamination in the soil (USEPA, 2015p). The USEPA has remediated soils at 19 residences and the schoolyard as part of a short-term cleanup to protect human health. USEPA is also providing bottled drinking water to 46 residences relying on contaminated private groundwater wells (USEPA, 2010b).

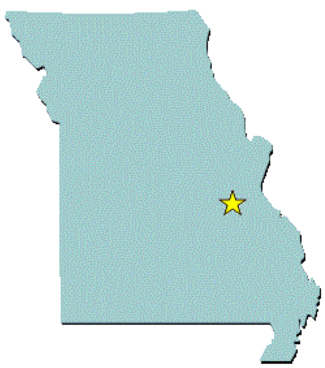

Figure 10.1.15-3: Chat Piles and Subsidence Ponds in Historic Lead Mining Area Richwoods, MO

Source: (MDNR, 2015l)

In Missouri, the MDNR, Land Reclamation Program, Abandoned Mine Lands Section administers mine reclamation projects funded by grants from the Surface Mining Control and Reclamation Act (SMCRA). The AML section is responsible for managing AML health and safety hazards resulting from pre-1977 mining operations (MDNR, 2015s). Figure 10.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Missouri, 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 November 2015, Missouri had 221 Priority 1 and 2 AMLs, with 250 unfunded problem areas (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015a).

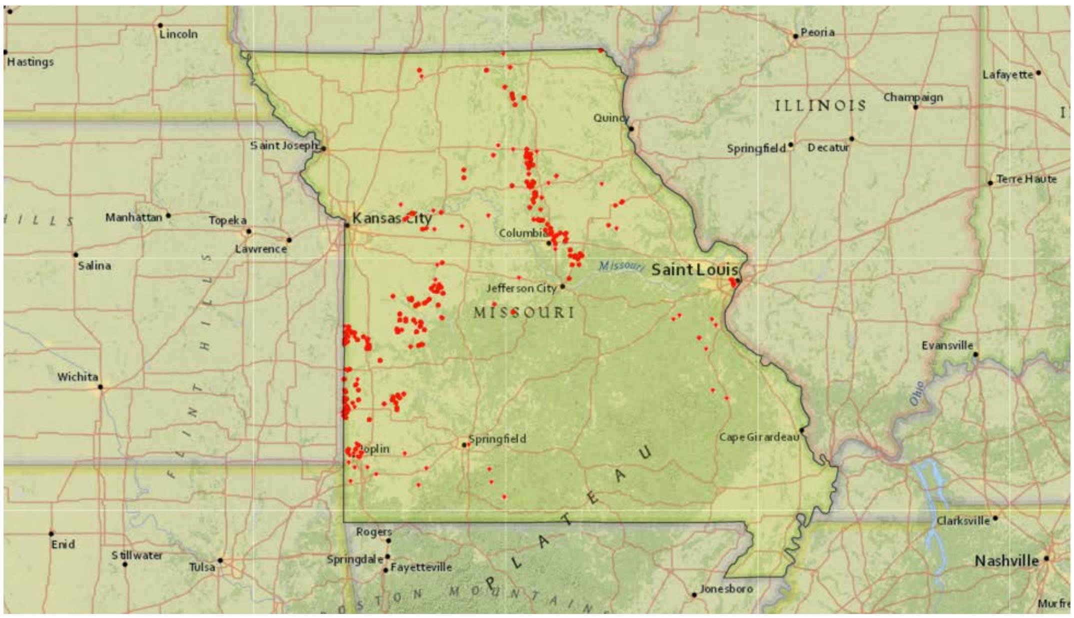

Figure 10.1.15-4: High Priority Abandoned Mine Lands in Missouri (2015)

Source: (U.S. Department of the Interior, Office of Surface Mining Reclamation and Enforcement, 2015b)

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. 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.

Public Health and Safety

Subterranean mines present additional health and safety risks to the general public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, mine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and mine fires in particular, can result in evacuations of entire communities (U.S. Department of the Interior, Office of Surface

Mining Reclamation and Enforcement, 2015c). Missouri promotes a "Stay Out, Stay Alive" campaign, to educate the public of the dangers of abandoned mines (MDNR, 2015s).

10.1.15.6. *Environmental Setting: 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 general public. Telecommunications, including public safety communications, can be unavailable (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.). Floodwaters are often contaminated by hazardous chemicals and sanitary wastes, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003).

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, MDHSS 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 184 NRC-reported incidents for Missouri in 2015 with known causes, six incidents were attributed to natural disaster (e.g., natural phenomenon), while 178 incidents were attributed to manmade disasters (e.g., derailment, dumping, equipment failure, operator error, over pressuring, transport accident, or trespasser) or other indeterminate causes (USCG, 2015). For example, according to the NRC, on May 22, 2011, a tornado damaged the Praxair gas and welding distribution center in Joplin, MO, causing a propane release that forced the evacuation of employees (USCG, 2011). Such incidents present unique, hazardous challenges to telecommunication workers during natural 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 general 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. Infrastructure damage was extensive during the Joplin Tornado in 2011, with several storage tank spills due to flooding and fallen transformers. In 2014, Missouri experienced 2 fatalities (one due to lightning and one due to flooding) and 29 weather-related injuries (NWS, 2015a). For comparison, in 2011, the year Missouri experienced severe tornados, there were 180 weather-related fatalities and 1,897 weather-related injuries (NWS, 2012).

Spotlight on Missouri Natural Disaster Sites: Joplin, MO Tornado

On the evening of May 22, 2011, an EF-5 tornado (wind gusts over 200 miles per hour) struck the City of Joplin, MO. The tornado resulted in 162 fatalities and hundreds of injuries, destroying a path six miles long and a mile wide. The Missouri Public Service Commission (MPSC) and the Empire District Electric Company estimated that 4,000 utility poles, 1,500 transformers, 110 miles of power line, and one electric substation were lost during the storm. More than 280 personnel from nearby utility companies were brought into the affected area to assist with repair activities (Figure 10.1.15-5). Missouri-American Water Company identified 4,000 leaks in water service lines, and issued a boil order for the public. Broken water lines can also cause landslides, sinkholes, and dangerous road conditions which may be hazardous to workers responding to disasters. (Missouri Public Service Commission, 2011)

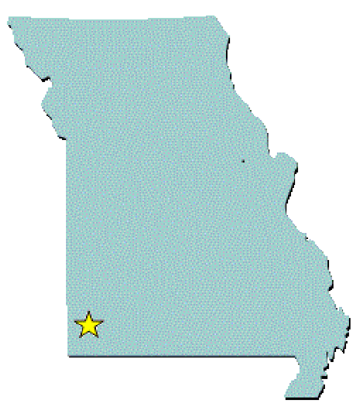

Figure 10.1.15-5: Crews repair poles after the May 22 tornado

Source: (Missouri Public Service Commission, 2011)

10.2. 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 categories of impacts are defined as potentially significant, less than significant with mitigation 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 as a result of construction activity. 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.

10.2.1. Infrastructure

10.2.1.1. *Introduction*

This section describes potential impacts to infrastructure in Missouri associated with construction, 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.1.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 10.2.1-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 10.2.1-1: Impact Significance Rating Criteria for Infrastructure

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 potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect 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 potentially significant, but with mitigation is less than significant.	Minor delays to access to care and emergency services that do not impact health outcomes.	No impacts 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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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

10.2.1.3. *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, or airport, 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, railway companies) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 10.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if such impacts would be realized at one or more isolated locations. Such 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 during construction 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 – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that construction 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 10.2.1-1, potential negative impacts would be less than significant. 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 10.2.1-1 any potential impacts would be less than significant during deployment, due to the temporary nature of the 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 given the short-term nature of the deployment activities.

Effects to Commercial Telecommunication Systems, Communications, or Level of Service

Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would likely be using a different spectrum for communications. 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.[144] Anticipated impacts would be less than significant due to the limited extent and temporary nature of the 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 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.

10.2.1.4. *Potential Impacts of the Preferred Alternative*

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities.

[144] 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 2.1.2, 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 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

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 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 to infrastructure resources.

Activities with the Potential to Have Impacts

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, 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.
  - 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.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts on infrastructure resources as mentioned above, installation of new associated huts or equipment, if required, could impact infrastructure resources, depending on the exact siting of such installation activities.
  - 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. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies 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 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.

- 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 such 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 comprised of cellular base stations, sometimes with expandable antenna masts, and generators that may require connection 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. Also, 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 launched or recovered on 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, although likely minor, impacts on utilities, if new infrastructure requires tie-in to the electric grid. 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, and system redundancy. These impacts are expected to be less than significant, due to the short-term nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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 result as explained above, although these potential impacts would be expected to be minor and temporary.

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 also 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.

10.2.1.5. *Alternatives Impact Assessment*

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.

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 less than significant impacts to infrastructure if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. 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 avoid any negative impacts to such resources. 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. These impacts are expected to be less than significant due to the temporary nature of the deployment.

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. If usage of heavy equipment, as part of routine maintenance or inspection occurs off of established access roads or utility ROWs, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts could occur to transportation systems or utility services.

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. As a result, there would be no impacts to infrastructure from deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

10.2.2. Soils

10.2.2.1. *Introduction*

This section describes potential impacts to soil resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.2.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 10.2.2-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact.

Table 10.2.2-1: Impact Significance Rating Criteria for Soils

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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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

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.

10.2.2.3. *Description of Environmental Concerns*

Soil Erosion

Soil erosion is an environmental concern of 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 Missouri 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 (NRCS, 2000). Areas exist in Missouri 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, Aquolls, Arents, Fluvents, Orthents, Udalfs, Udepts, Udolls, and Udults (see Section 10.1.2.4, Soil Suborders and Figure 10.1.2-2).

Based on the impact significance criteria presented in Table 10.2.2-1, building of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades. Furthermore, deployment sites that are large-scale or adjacent to other construction sites (i.e., cumulatively large-scale sites) could result in long-term erosion that might not be reversed for several years.

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, as defined through consultation with the appropriate resource agency, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 10.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet Proposed Action sites minimal topsoil mixing is anticipated. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize 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. Heavy equipment could cause perceptible compaction and rutting of susceptible soils, particularly if BMPs and mitigation measures are not implemented.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 10.1.2.4, Soil Suborders). The most compaction susceptible soils in Missouri are hydric soils with poor drainage conditions, which include Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, and Psamments. These suborders constitute approximately 20.6 percent of Missouri's land area[145], and are found mostly in the northern, eastern, and southeastern portions of the state (Figure 10.1.2-2). 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 10.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant due to the extent of susceptible soils in the state. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.2.4. *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 in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

[145] 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.

Activities Likely to Have No Impacts

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 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 not impact soil resources 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. 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.
- 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 not impact 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 to soil resources.

Activities with the Potential to Have Impacts

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

paved, 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: 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.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic plants in limited near the shore or inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable.146 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: 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: Collocation 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 are needed that may require 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: 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,

[146] Potential impact of submarine fiber optic plant installation to waterbody sediments is evaluated in Water Resources (Section 10.2.4)

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. Where technologies such as COWs, COLTs, and SOWs are deployed on existing paved surfaces, there would be no impacts to soil resources because there would be no ground disturbance.

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 due to the limited extent and temporary nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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. 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. These impacts are expected to be less than significant, due to the limited extent and temporary nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.2.5. *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 if 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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. 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 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, due to the limited extent and temporary nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.2, Soils.

10.2.3. Geology

10.2.3.1. *Introduction*

This section describes potential impacts to Missouri geology resources 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.3.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 10.2.3-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 geology addressed in this section are presented as a range of possible impacts.

Table 10.2.3-1: Impact Significance Rating Criteria for Geology

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 Proposed Action activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located within an earthquake hazard zone or active fault.	No likelihood of a Proposed Action 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 Proposed Action activity could be located near a volcano lava or mud flow area of influence.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located near a volcanic ash area of influence.	No likelihood of a Proposed Action 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 Proposed Action activity could be located within a landslide area.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action activity could be located within a landslide area.	No likelihood of a Proposed Action activity located within a landslide hazard area.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	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
Land Subsidence	Magnitude or Intensity	High likelihood that a Proposed Action activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a Proposed Action 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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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

10.2.3.3. *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, landslides, and volcanic activity, and those that would be impacts from the project, such as land subsidence, mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic Hazards

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 10.1.3.8, eastern and southeastern Missouri lie on a fault line and are at risk of significant earthquake events. As shown in Table 10.2.3-1, southeastern Missouri is at greatest risk of earthquakes, and some estimate that an earthquake of magnitude from 7.0 to 8.0 on the Richter scale has a 10% chance of occurrence in a 50-year period. Based on the impact significance criteria presented in Table 10.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have no impact on seismic activity; however, given the potential for minor to moderate earthquakes in parts of Missouri, seismic impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within high-risk earthquake hazard zones or active fault 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. Given the potential for minor earthquakes in or near Missouri, some amount of infrastructure could be subject to earthquake hazards. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Volcanic Activity

Volcanoes were considered but not analyzed for Missouri, as no active volcanoes occur in Missouri; therefore, volcanoes do not present a hazard to the state.

Landslides

As discussed in Section 10.1.3.8, Missouri is at low risk of experiencing landslide events. The highest potential for landslides in Missouri is found north of the Missouri River and includes loess along major river valleys and clay till on slopes underlain with shale. Additionally, a few events have occurred along the Mississippi River in areas underlain by shale and limestone. Based on the impact significance criteria presented in Table 10.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would have less than significant impacts due to the small-scale nature of the deployment; 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. 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. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Missouri's major cities, including Kansas City, Columbia, St. Joseph, and St. Louis, are in areas that experience landslides, some amount of infrastructure could be subject to landslide hazards. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Land Subsidence

As discussed in Section 10.1.3.8 and shown in Figure 10.1.3-6, portions of Missouri are vulnerable to land subsidence due to karst topography, aquifer system compaction, soil drainage, underground mining, sinkholes and thawing permafrost. Based on the impact significance criteria presented in Table 10.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have less than significant impacts, due to the small-scale nature of the deployment; however, subsidence impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas at high risk to karst topography, mine collapse, or inundation due to long-term land subsidence. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography could be 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 rise[147] and inundation of equipment. All of these activities could result in connectivity loss. Given the potential for karst topography in Missouri, some amount of infrastructure could be subject to landslide hazards. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Mineral and Fossil Fuel Resources

Equipment deployment near mineral and fossil fuel resources are not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 10.2.3-1, impacts to mineral and fossil fuel resources are unlikely as the Proposed Action could only be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable and feasible, FirstNet would likely avoid construction in areas where these resources exist.

[147] 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)

Paleontological Resources

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 10.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 10.1.3.6, Paleontological Resources, such as crinoids, trilobites, brachiopods, and bryozoans, can be found in over 10 counties within the state (MDNR, 2008). Potential impacts to fossil resources should be considered on a site-by-site basis. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 10.2.3-1, impacts would 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 less than significant, because they are not likely to require removal of significant volumes of terrain. When ground disturbance is required, 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.3.4. *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

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

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. In most cases, there would be no impacts to geologic resources 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 geologic resources because there would be no ground disturbance.
  - 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. 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).
- Satellites and Other Technologies
  - 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 to geologic resources.

Activities with the Potential to Have Impacts

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: 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.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near 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: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations 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: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if the delivery of 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: 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. 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.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures, or the use of portable devices that use satellite technology would not impact 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 geology associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects 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. These impacts are expected to be less than significant. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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.

10.2.3.5. *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 due to the small scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant due to the small scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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) from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.3, Geology.

10.2.4. Water Resources

10.2.4.1. *Introduction*

This section describes potential impacts to water resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.4.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 10.2.4-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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.

10.2.4.3. *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.

Of the 88 percent of Missouri's assessed lakes, reservoirs, and ponds, 27.2 percent are impaired. In comparison, of the assessed state rivers and stream miles (20 percent), 54 percent are impaired (Table 10.1.4-2, Figure 10.1.4-3). Various sources affect Missouri's waterbodies, causing impairments, but top causes include dissolved oxygen, mercury, lead, pathogens, chlorophyll-A/algal growth, and nitrogen. Groundwater quality within the state is generally suitable for drinking and daily water needs (MDNR, 2014e).

Deployment activities could contribute to water quality impacts in a number of ways but primarily as 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 would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Table 10.2.4-1: Impact Significance Rating Criteria for Water Resources

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 potentially significant, but with mitigation is less than significant.	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*	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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

* - Since public safety infrastructure is considered a critical facility, Proposed Action activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690).
NA = Not Applicable

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 and mitigation measures could help reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), or 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 10.2.4-1, water quality impacts would likely be less than significant, due to the small scale and temporary nature of the deployment. Impacts 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 Proposed Action area. If trenching[148] 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 Missouri dewatering requirements. Any groundwater extracted during dewatering activities, or as required by a dewatering permit, may need to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Missouri aquifers, there is little potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking water quality violation, or otherwise substantially degrade groundwater quality or in an aquifer, and based on the impact significance criteria presented in Table 10.2.4-1, there would likely be less than significant impacts on groundwater quality.

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 humans, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard,

[148] 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).

where there is a 0.2-percent-annual-chance of flooding. Some Proposed Action activities 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 10.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would likely occur inside the 500-year floodplain, use minimal fill, do not substantially increase impervious surfaces, do not impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would likely be temporary, lasting no more than one season or water year,[149] or occur only during an emergency.

Examples of activities that would have less than significant impacts include:

- Construction of any structure in the 500-year floodplain that 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.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented to help reduce the risk of additional impacts of floodplain degradation. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 10.2.4-1, 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.

Example of Proposed Action s that could have minor changes to the drainage patterns include:

[149] 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, 2016d)

- Land uses with pervious surfaces that create limited stormwater runoff.
- Activities designed so that 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 drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant 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 10.2.4-1. 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 (no more than six months) are likely to have less than significant impacts 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 that 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 water bodies 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 to flow alteration. BMPs and mitigation measures could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 10.1.4.7, approximately 30 percent (1.8 million) of Missouri residents rely on 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. Generally, the water quality of Missouri'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 cause any impacts to water quality. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Bulk 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 will likely have less than significant impacts since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should, as practical and feasible, be considered to avoid areas that would extract groundwater from potable groundwater sources in the area.

10.2.4.4. *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 water 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 potentially 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) 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).

Activities Likely to Have No Impacts

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 water 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 impacts to water resources 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 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.
  - 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 to water resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of 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. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in 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 and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would impact water resources from a short-term increase in

suspended solids in the water. Site-specific impact assessment would be required to marine and shoreline environments prior to installation to fully assess potential impacts to lake or river environments.
  - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids. Groundwater impacts from trenching activities are not expected. 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 Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids that could occur during the replacement of poles and structural hardening.
  - 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. If 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.
- 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 and mitigation measures 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. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, impacts to water resources could occur, including increased suspended solids leading to impaired water quality and impacts to groundwater from excavation.
  - 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 the amount of 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 because there would be no ground disturbance. Deployment of drones, balloons, blimps, aerostats, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters.

- Deployable Aerial Communications Architecture: 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; 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 could include water quality impacts. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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, and are expected to have no impacts. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected.

10.2.4.5. *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.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts 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. These 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. The amount of potential impact depends on the land area affected, installation technique, and location. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be less than significant impacts 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 of time, 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. Site maintenance, including mowing or herbicides, may result in less than significant effects 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.

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 water resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.4, Water Resources.

10.2.5. Wetlands

10.2.5.1. *Introduction*

This section describes potential impacts to wetlands in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.5.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 10.2.5-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 10.2.5-1: Impact Significance Rating Criteria for Wetlands

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 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 potentially significant, but with mitigation is less than significant.	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	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.		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 high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	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 high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	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
Indirect effects: [b] change in function(s)[c] change in wetland type	Magnitude[a] or Intensity	Changes to the functions or type 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.).	Effect that is potentially significant, but with mitigation is less than significant.	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	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		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 (USACE 2014). 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

10.2.5.3. *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, 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 given the amount of land disturbance associated with the project locations (generally less than an acre). Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

There are more than 1.3 million acres of wetlands throughout Missouri (USFWS, 2014a). Palustrine (freshwater) wetlands are found on river and lake floodplains across the state, as shown in Section 10.1.5, Figure 10.1.5-1.

In Missouri, as discussed in Wetlands, Section 10.1.5.4, areas classified as a fen, seep, or bog are protected under the USACE Nationwide permit. Groundwater seeps, also called acidic seeps or fens, are typically found in the Ozarks, along the base of hillsides, where groundwater percolates up to the surface. These seeps commonly accumulate peat and muck from the constantly saturated conditions. Fens are found where alkaline groundwater percolates up through limestone and dolomite, usually in springs, sinkholes, caves, and karst landscapes in the Ozarks. Dominant vegetation includes wildflowers, bulrushes (*Typha sp.*), and sedges (*Cyperaceae sp.*). Acidic seeps are found where groundwater flows through rocks such as sandstone, sands, and igneous rocks. These seeps typically contain ferns and mosses (*Bryophyta sp.*), and are found in the Ozarks, and in southeast Missouri along Crowley's Ridge (Leahy, 2001).

If any of the proposed deployment activities were to occur in high quality wetlands, potentially significant impacts could occur. Site-specific analysis would likely be needed to determine the quality of wetlands. BMPs and mitigation measures could be implemented to help avoid potentially significant impacts to wetlands. Based on the impact significance criteria presented in Table 10.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands, due to the small-scale nature of the deployment. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and local regulations.

Potential Other Direct Effects

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, 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 mechanical or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 10.2.5-1, 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 high quality wetlands within a watershed or multiple watersheds could be potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant 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 local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Missouri 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 stormwater 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 parameters.

- 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:[150] Change in Function(s)[151] 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 both high- and low-quality wetlands would be less than significant 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 local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Examples of functions related to wetlands in Missouri 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.
- 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

[150] 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.

[151] 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.

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 10.2.5-1, 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 potentially less than significant. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.5.4. *Potential Impacts of the Preferred Alternative*

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations could be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

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 wetlands 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 potentially significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 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 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 wetlands 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 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 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 wetlands, it is anticipated that this activity would have no impact to wetlands.

Activities with the Potential to Have Impacts

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., high quality). Any ground disturbance could cause direct and/or 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 nearshore or 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 riverine 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 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 hunts, 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 help 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 the delivery of 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.
  - 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, and 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., high quality). 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 due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 could be ongoing other potential direct impacts to wetlands from routine operations and maintenance application of herbicides to control vegetation along all ROWs and near structures, depending on the proximity of wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. Impacts to water quality would likely be less than significant for operations and maintenance activities as it is anticipated that such herbicide applications would be intermittent and use a minimal amount of herbicides. Implementation of BMPs and mitigation measures could reduce the impacts from herbicide application.

10.2.5.5. *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.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts 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/or 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 due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 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.

It is anticipated that there would be less than significant impacts to wetlands associated with routine inspections of the Deployable Technologies Alternative. Site maintenance, including mowing or herbicides, is anticipated to result in less than significant effects to wetlands, depending on the proximity to, wetland type, and amount of herbicides used. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on wetlands, as explained above.

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 wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.5, Wetlands.

10.2.6. Biological Resources

10.2.6.1. *Introduction*

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.6.2. *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 10.2.6-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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 10.2.6.3, 10.2.6.4, and 10.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 10.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Missouri.

Table 10.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

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 potentially significant, but with BMPs and mitigation measures is less than significant.	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 Missouri 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 potentially significant, but with BMPs and mitigation measures is less than significant.	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 Missouri 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 potentially significant, but with BMPs and mitigation measures is less than significant	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 Missouri 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 potentially significant, but with BMPs and mitigation measures is less than significant.	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 Missouri 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 potentially significant, but with BMPs and mitigation measures is less than significant.	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 Missouri 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 potentially significant, but with BMPs and mitigation measures is less than significant.	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 Missouri.		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, 2016)
NA = Not Applicable

10.2.6.3. *Terrestrial Vegetation*

Impacts to terrestrial vegetation occurring in Missouri 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 10.2.6-1, 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. Direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, these events are expected to be relatively small in scale. The implementation of BMPs and mitigation measures and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival.

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 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. Agriculture accounts for the largest portion of land use (51 percent) and forest and woodland is the second largest area of land use (38 percent) of the total land area (Table 10.1.7-1) (NRCS, 2010).

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. Further, if proposed sites with sensitive or rare regional vegetative communities are unavoidable, BMPs and mitigation measures could be implemented to help minimize or avoid 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. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the 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.

When non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. Natural or native community species evolve together into an ecosystem with many checks and balances that limit the population growth of any one species. These checks and balances include such things as: predators, herbivores, diseases, parasites, and other organisms competing for the same resources and limiting environmental factors. However, when an organism is introduced into an ecosystem in which it did not evolve naturally, those limits may not exist and its numbers could sometimes dramatically increase. The unnaturally large population numbers could then have severe impacts to the environment, local economy, and human health. Invasive species could out-compete the native species for food and habitats and sometimes even cause their extinction. A total of 12 state-listed noxious weeds are regulated in Missouri according to MRS 263.190 and 263.200. Of these species, 11 are terrestrial and 1 is an aquatic species (MDA, 2015).

The potential to introduce invasive plats 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 could help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action.

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, 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[152], and the nature as well as the extent of the habitats affected.

Activities Likely to Have No Impacts

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 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 to terrestrial vegetation.

Activities with the Potential to Have Impacts

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:

[152] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

- 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. 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 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. Implementation of 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 limited nearshore and inland 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 shore to accept 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 Implementation of 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, vegetation loss, and invasive species effects.
- Wireless Projects
  - New Wireless Communication Towers or Backhaul Equipment: 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. These impacts are expected to be less than significant due to the relatively small scale of FirstNet activities at individual locations. 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 19, BMPs and Mitigation Measures, 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 above mentioned 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 be 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. Site maintenance, including mowing or herbicides, may result in less than significant effects to terrestrial vegetation 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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. However, impacts are expected to remain less than significant due to the relatively small scale of FirstNet activities at individual locations. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 to terrestrial vegetation associated with routine operations, management, and monitoring due to the relatively small scale of likely FirstNet project sites. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to be less than significant.

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 terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.6.3, Terrestrial Vegetation.

10.2.6.4. *Wildlife*

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Missouri 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 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 10.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of the proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) 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.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Missouri. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors (USDOT FHWA, 2008). 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.

If 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 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 help avoid disturbance to bats.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and could violate MBTA and BGEPA. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), night-migrating birds, 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 nesting 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 injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions.

Direct mortality and injury to birds of Missouri are not likely to be widespread or affect populations of species as a whole; individual species impacts may be realized depending on the nature of the deployment activity. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures developed in consultation with USFWS. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

These species 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. Of the 118 native reptile and amphibian species, 35 SGCN have been identified (MDC, 2016d). Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Environmental consequences pertaining to amphibians are discussed in Section 10.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Missouri 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

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 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, and impeding access to resources and mates. Agriculture accounts for the largest portion of land use (51 percent) and forest and woodland is the second largest area of land use (38 percent) of the total land area (Table 10.1.7-1) (NRCS, 2010).

Additionally, 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 could 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.

Potential effects of vegetation and habitat loss, alteration, or fragmentation are described for Missouri's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Missouri and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear) by decreasing the availability of forest for cover from predators or 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 implementing BMPs and mitigation measures.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the Missouri Department of Conservation (MDC) provides 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 locations, and cover habitat.

Noise 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).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[153] 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 (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Missouri's amphibians and reptiles typically consist of wetlands and the surrounding upland forest. Impacts are expected to be less than significant given the anticipated small size and nature of the majority of the proposed deployment activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Filling or draining of wetland breeding habitat (see Section 10.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Missouri amphibian and reptile populations, though BMPs and mitigation measures could help to avoid or minimize the potential impacts[154].

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 10.2.6.6, 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

[153]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.

[154] See Section 10.2.5, Wetlands, for a discussion of BMPs for wetlands.

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, 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, therefore repeated disturbances would be unlikely to occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant 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). The majority of FirstNet deployment activities would be short-term in nature, therefore repeated disturbances would be unlikely to occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant 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, therefore repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

Terrestrial Invertebrates

Terrestrial 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.

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. Potential effects to migration patterns of Missouri's amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Some large mammals (e.g. black bears) 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[155]. Any clearance, drilling, and construction activities needed for network deployment, including noise 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 given the anticipated small size and temporary nature of the proposed deployment activities. 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 19, BMPs and Mitigation Measures, 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 vast distances often involving many different countries. For example, as a group, shorebirds migrating through Missouri undertake some of the longest-distance migrations of all animals. According to the National Audubon Society (NAS), a total of 47 IBAs have been identified in Missouri, including breeding[156], migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, forests, large rivers, and wetland/riparian[157] areas (NAS, 2015). Many migratory routes are passed from one generation to the next. 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 given the anticipated small size and temporary nature of the proposed deployment activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate. For example, wood frogs (*Rana sylvatica*) 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). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but any impacts are expected to be less than significant given the

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[155] Hibernacula: A location chosen by an animal for hibernation (Merriam Webster Dictionary, 2015c).

[156] Breeding range: "The area utilized by an organism during the reproductive phase of its lifecycle and during the time that young are reared. " (USEPA, 2015v).

[157] Riparian: "Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands" (USEPA, 2015v).

anticipated small size and temporary nature of the proposed deployment activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Missouri's terrestrial 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.

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 Missouri.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale and impacts are expected to be less than significant. 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 and noise) 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). The majority of FirstNet deployment or operation activities are likely to be small scale in nature. BMPs and mitigation measures as defined through consultation with USFWS, if required, could help to avoid or minimize any potential impacts.

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, 2011b).

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, 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.

Terrestrial Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; no reproductive effects to terrestrial 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.

Potential invasive species effects to Missouri’s wildlife are described below.

Terrestrial Mammals

In Missouri, feral hogs (*Sus scrofa*) adversely impact several native large and small mammals. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (MDC, 2015m).

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. Invasive species effects to terrestrial mammals could be further minimized following BMPs in Chapter 19. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. For example, in Missouri, European starlings (*Sturnus vulgaris*) could impact native birds by aggressively competing for tree cavities (MDC, 2016e). 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 bird species are not expected to be introduced at project sites as part of the deployment activities.

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 from machinery or laborers during deployment operations.

Terrestrial Invertebrates

Terrestrial 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 terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects pose a large threat to forest and agricultural resources (USFS, 2015d). 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. 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, as defined through consultation with the appropriate resource agency, would be implemented to minimize the potential for introducing invasive plant species during implementation of the Proposed Action. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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, 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.

Activities Likely to Have No Impacts

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 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 on 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 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 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 wildlife resources, it is anticipated that this activity would have no impact to wildlife resources.

Activities with the Potential to Have Impacts

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 development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources 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 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, 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 facilitates 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 individual species 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 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 limited nearshore and inland bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could potentially impact wildlife (see Section 10.2.4, 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 time 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/or indirect injury or mortality, effects to migratory 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 which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, 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, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. For a discussion of radio frequency 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. 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 given the small scale of likely individual FirstNet projects; however, 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. The specific deployment activity and where the deployment will take place would be determined based on location-specific conditions and the results of site-specific environmental reviews. 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 19, BMPs and Mitigation Measures, 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. 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 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 to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could 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 individual wildlife species and unlikely to cause population-level impacts. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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.

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in less than significant impacts 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 because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 and geographic region. 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 19, BMPs and Mitigation Measures, 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. As a result, there would be no impacts to wildlife resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.6.4, Terrestrial Wildlife.

10.2.6.5. *Fisheries and Aquatic Habitats*

Impacts to fisheries and aquatic habitats occurring in Missouri 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 entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 10.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (but minimal for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects 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

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 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, construction of new infrastructure and long-term facility maintenance could result in the 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. Additionally, deployment activities with the potential for impacts to sensitive aquatic habitats would be addressed through BMPs and mitigation measures, as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

Water quality impacts from exposure to contaminants from accidental spills from vehicles and equipment, and erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats 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. These impacts are expected to be less than significant given the anticipated small size of the proposed deployment activities, and BMPs and mitigation measures to protect water resources (see Section 10.2.4, 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. FirstNet deployment impacts are anticipated to be localized and at a small scale, and would vary depending on the species, time of year, and duration of deployment. Impacts are expected to be less than significant, and are anticipated to be localized and at a small scale, and would vary depending on the species, time of year, and duration of deployment. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

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. 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 expected to be less than significant, given the anticipated small size and temporary nature of the proposed deployment activities. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invasive Species Effects

The potential to introduce invasive plants 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 and 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 impacts are expected to be less than significant. BMPs and mitigation measures could help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

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 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.

<u>Activities Likely to Have No Impacts</u>

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, 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 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 on fisheries and aquatic habitats because there would be no disturbance of the aquatic environment. If required, and if done in existing

huts, installation of new associated equipment would also result in no disturbance and have no impacts to fisheries and aquatic habitats. The section below addresses potential impacts to fisheries and aquatic habitats if construction of new huts or other equipment is required or construction for laterals/drops is conducted.

- 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

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. 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 facilitates 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, if conducted near water resources that

support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and 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 (some fish). Disturbance, including noise, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
- 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. 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 which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, or structural hardening are required, 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. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps 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 due to the relatively small scale of FirstNet activities at individual locations. 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 19, BMPs and Mitigation Measures, 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. 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 there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections or site maintenance activities associated with the of the Proposed action. Site maintenance that might include accidental spills from maintenance equipment or pesticide runoff near fish habitat are anticipated to result in less than significant effects to fisheries and aquatic habitats due to the limited nature of such activities and the likely small quantities of potentially harmful liquids used.

Fisheries and aquatic invertebrates 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.

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.

<u>Deployment Impacts</u>

As explained above, implementation of deployable technologies could result in less than significant impacts 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

<u>Operational Impacts</u>

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 to fisheries and aquatic habitats associated with routine operations, management, and monitoring. The impacts could vary greatly among species and geographic region, but they are still expected to remain less than significant given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, 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. As a result, there would be no impacts to fisheries and aquatic habitats as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.6.5, Fisheries and Aquatic Habitats.

10.2.6.6. *Threatened and Endangered Species and Species of Conservation Concern*

This section describes potential impacts to threatened and endangered species in Missouri 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 19, BMPs and Mitigation Measures, 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 10.2.6-2. 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. 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.

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 10.2.6-2, any direct injury or mortality of a listed species at the individual-level could be potentially significant as well as any impact that has more than a negligible potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Missouri are described below.

<u>Terrestrial Mammals</u>

There are three endangered and one threatened mammal species federally listed and known to occur in the state of Missouri; they include the gray bat (*Myotis grisescens*), Indiana bat (*Myotis sodalist*), northern long-eared bat (*Myotis septentrionalis*), and Ozark big-eared bat (*Corynorhinus townsendii ingens*).

Table 10.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristic	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 likely to adversely affect 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 Characteristic	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 likely to adversely affect 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 adverse effect 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.	

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, 2016b) (USFWS, 2015bc). 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, 1997b) (USFWS, 2015i). 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 or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997b).

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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

Three federally listed bird species are known to occur in the state of Missouri; they include the least tern (*Sterna antillarum*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*). Depending on the project types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with man-made cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. If proposed project sites are 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Fish

Three endangered, three threatened, and one candidate fish species federally listed and known to occur in the state of Missouri; they include the grotto sculpin (*Cottus specus*), Neosho madtom (*Noturus placidus*), Niangua darter (*Etheostoma nianguae*), Ozark cavefish (*Amblyopsis rosae*), pallid sturgeon (*Scaphirhynchus albus*), and Topeka shiner (*Notropis topeka*). The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species could occur from vessel/boat strikes or entanglements resulting from the Proposed Action but are unlikely as the majority of FirstNet deployment projects would not occur in the aquatic environment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One amphibian species is federally listed and known to occur in Missouri, the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury could occur from watercraft and vessels strikes are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Missouri. Therefore, no injury or mortality effects to federally threatened and endangered reptiles are expected as a result of the Proposed Action.

Invertebrates

Fourteen endangered and one threatened invertebrate species are federally listed and known to occur in the state of Missouri. Thirteen of these species are mollusks and two of these species are terrestrial invertebrates. The majority of FirstNet deployment projects would not occur in an aquatic environment. 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. In general, distribution of these species is limited throughout the state. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

Nine federally listed plant species and known to occur in the state of Missouri; they include earth fruit (*Geocarpon minimum*), decurrent false aster (*Boltonia decurrens*), eastern prairie fringed orchid (*Platanthera leucophaea*), Mead's milkweed (*Asclepias meadii*), Missouri bladderpod (*Physaria filiformis*), pondberry (*Lindera melissifolia*), running buffalo clover (*Trifolium stoloniferum*), Virginia sneezeweed (*Helenium virginicum*), and western prairie fringed orchid (*Platanthera praeclara*). 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. 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 19, BMPs and Mitigation Measures, 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 either 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 Missouri are described below.

Terrestrial Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

Noise, light, or human disturbance within nesting areas could cause federally listed birds to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One amphibian species is federally listed and known to occur in Missouri, the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). The majority of FirstNet deployment projects would not occur in an aquatic environment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Missouri. Therefore, no injury or mortality 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), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 10.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to federally listed fish species in Missouri are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality from ground disturbing activities could cause stress resulting in lower productivity for the federally listed scaleshell mussel known to occur in Nebraska. Impacts to habitat, including loss and fragmentation, and reduced food supply could result in reduced survival and reproduction for listed invertebrates. Impacts associated with deployment activities are expected to result in less than significant changes to water quality given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken.

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, amphibians, fish, invertebrates, and plants with known occurrence in Missouri are described below.

Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. 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 19, BMPs and Mitigation Measures, 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 vast distances often involving many different countries. For example, the piping plover use sites throughout Missouri 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, 2003a). Disturbance in stopover, foraging, or breeding areas (visual or noise) 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 adverse effects to federally listed birds. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could adversely affect nesting and foraging sites of the federally listed amphibian species, resulting in reduced survival and productivity; however, disturbances during deployment activities are not anticipated to stress the one federally listed amphibian, the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No federally listed reptiles are known to occur in Missouri. 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 disturbing activities could impact food sources for the federally listed fish species in Missouri. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon spawning locations or alter migration patterns. 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 19, BMPs and Mitigation Measures, 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 survival. 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 19, BMPs and Mitigation Measures, 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. FirstNet activities are generally expected to be small-scale in nature, therefore large-scale impacts are not expected; however, it is possible that small-scale changes could lead to potentially significant adverse effects for certain species. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Threatened and endangered species with critical habitat in Missouri are presented below.

Terrestrial Mammals

The Indiana bat has designated critical habitat in five counties within Missouri (Figure 10.1.6-3). 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

No designated critical habitat occurs for birds in Missouri. 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

There is no designated critical habitat for the Ozark hellbender (*Cryptobranchus alleganiensis bishopi*), the one listed amphibian in Missouri. Additionally, there are no federally listed reptile species in Missouri. 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

One of the federally listed fish species in Missouri have federally designated critical habitat. Critical habitat for the Niangua darter was designated in portions of the Niangua River, Big Tavern Creek, Little Niangua River, Pomme de Terre River, and Brush Creek. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Three of the federally listed invertebrate species in Missouri have designated critical habitat. Critical habitat for the Neosho mucket (*Lampsilis rafinesqueana*) includes segments of the Elk River, Shoal Creek, Spring River, and North Fork Spring River. Critical habitat for the rabbitsfoot (*Quadrula cylindrica cylindrica*) includes segments of the Spring River and St. Francis River. Critical habitat for the Tumbling Creek cavesnail (*Antrobia culveri*) includes the entire length of Tumbling Creek. The Hine's emerald dragonfly (*Somatochlora hineana*) has designated critical habitat in five counties in Missouri. Land clearing, excavation activities, and other ground disturbing activities in these regions of Missouri could lead to habitat loss or degradation, which could lead to adverse effects to these invertebrates depending on the duration, location, and spatial scale of the associated activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed invertebrate species in Missouri; therefore, no effect to those species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Plants

No designated critical habitat occurs for plants in Missouri. 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 effect to may affect but not likely to adversely affect depending on the deployment scenario or site-specific conditions. 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.

Activities Likely to Have No Effect

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 to 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, 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 on 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 not impact threatened or endangered species 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 protected species, it is anticipated that this activity would have no impact to protected species.

<u>Activities with the Potential to Affect Listed Species</u>

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 – Submarine Fiber Optic Plant: The installation of cables in bodies of water and construction of landings and/or facilities on the shore to accept submarine cables could 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 effects 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., 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, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - 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 facilitates 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 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 nearshore and 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 10.2.4, 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 affect 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, impacts could be similar to new wireless construction. Hazards related 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 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, piloted aircraft, or blimps 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.

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. These impacts may affect, but are not likely adversely affect protected species due to the short-term nature of the projects. 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 19, BMPs and Mitigation Measures, 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. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

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 in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. 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 19, BMPs and Mitigation Measures, 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. 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 19, BMPs and Mitigation Measures, 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.

<u>Deployment Impacts</u>

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. 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 19, may be implemented as appropriate to further minimize potential impacts.

<u>Operational Impacts</u>

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 activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. 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 19, BMPs and Mitigation Measures, 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. As a result, there would be no effects to threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.6.6, Threatened and Endangered Species and Species of Concern.

10.2.7. Land Use, Recreation, and Airspace

10.2.7.1. *Introduction*

This section describes potential impacts to land use, recreation, and airspace resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.7.2. *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 10.2.7-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 10.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with Mitigation 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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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 Mitigation 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 potentially significant, but with mitigation is less than significant.	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, 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 potentially significant, but with mitigation is less than significant.	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 Mitigation 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 potentially significant, but with mitigation is less than significant.	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

10.2.7.3. *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. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other above-ground 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 10.2.7-1, less than significant impacts 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 rights-of-way 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 above-ground 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 10.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale and only short-term impacts during the construction phase would be expected.

Loss of Access to Public or Private Recreation Land or Activities

Access to public or private recreation land or activities could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of ROW or easement. 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 10.2.7-1, less than significant impacts 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. Enjoyment of recreation land could be temporarily impacted by crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features. 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 impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 10.2.7-1, less than significant impacts 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. 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 10.2.7-1, 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 of time, FirstNet would not impact airspace resources.

10.2.7.4. *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 depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 rights-of-way.
    - <u>Land Use</u>: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts 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 10.1.7.5 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.
    - <u>Land Use</u>: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - <u>Recreation</u>: See Activities Likely to Have Impacts below.
    - <u>Airspace</u>: It is anticipated that there would be no impacts to airspace 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 10.1.7.5 Obstructions to Airspace Considerations).
  - 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.
    - <u>Land Use</u>: See Activities Likely to Have Impacts below.
    - <u>Recreation</u>: See Activities Likely to Have Impacts below.

    - Airspace: Installation of new poles would not have an effect 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 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 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 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 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 because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts on airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact 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 10.1.7.5 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 Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts 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 10.1.7.5 Obstructions to Airspace Considerations).

- 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 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.
    - Recreation: See Activities Likely to Have Impacts below.
  - Airspace: See Activities Likely 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 to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 10.1.7.5 Obstructions to Airspace Considerations.
- 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 to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: 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 airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - 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 to land use, it is anticipated that this activity would have no impact to land use.

Activities with the Potential to Have Impacts

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 rights-of-way.
        - 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 are anticipated – see previous section.
    - 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 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 Likely to Have Impacts below.
        - Airspace: It is anticipated that there would be no impacts to airspace 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.
    - 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 rights-of-way 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 are anticipated – see previous section.
    - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
        - Land Use: Deployment 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 nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
        - Airspace: No impacts 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 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 the other criteria listed in Section 10.1.7.5 Obstructions 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 Missouri'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 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 are anticipated – see previous section.
    - Recreation: No impacts 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 Missouri airports (See obstruction criteria in Section 10.1.7.5 Obstructions to Airspace Considerations). 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 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, including the construction of access roads. 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 to airspace or affect flight profiles and operating parameters of SUAs/MTRs. These impacts are expected to be less than significant given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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. The degree of change in the visual environment (see Section 10.2.8, 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. 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.7.5. *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.[158]

[158] As mentioned above and in Section 6.2.1.3, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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 to land use if deployment occurs in areas with compatible land uses. While a single deployable technology may have imperceptible impacts, 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. Implementation of deployable technologies could result in less than significant impacts to airspace from obstructions to airspace or affect flight profiles and operating parameters of SUAs/MTRs. 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 19, may be implemented as appropriate to further 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 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 due to the short-term nature of the deployment activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 10.1.7, Land Use, Recreation, and Airspace.

10.2.8. Visual Resources

10.2.8.1. *Introduction*

This section describes potential impacts to visual resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.8.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 10.2.8-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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.

10.2.8.3. *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 Missouri, residents and visitors travel to many national monuments, historic sites, and state parks, such as Ozark National Scenic Riverway to view its clear rivers, freshwater springs, caves, and trails. 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.

MRS Sections 253.408-412 and 253.415.1 regulate impacts to visual resources through protection of historic sites, buildings, and archaeological remains via state and local historic preservation acts, which empower the Department of Natural Resources and local government to preserve resources with "scenic significance to the locality, state or nation." 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 10.2.8-1, 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. Given the small scale of likely FirstNet activities, impacts are expected to be less than significant.

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.

Based on the impact significance criteria presented in Table 10.2.8 1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term could 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 with implementation of BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

Table 10.2.8-1: Impact Significance Rating Criteria for Visual Resources

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 potentially significant, but with mitigation is less than significant.	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 potentially significant, but with mitigation is less than significant.	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.

10.2.8.4. *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 depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 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 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 on 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 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 to visual resources.

Activities with the Potential to Have Impacts

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 located 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 rights-of-ways 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 nearshore and inland bodies of water would not impact visual resources. 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 to visual resources could occur but effects would be highly 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 the delivery of 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 of 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, although certain discrete locations could have potentially greater impacts to night skies or as a result of new towers. Given the small scale of likely FirstNet activities, impacts are expected to be less than significant. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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 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.

10.2.8.5. *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 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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 given the temporary and small-scale nature of the operations. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units.

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 visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.8, Visual Resources.

10.2.9. Socioeconomics

10.2.9.1. *Introduction*

This section describes potential impacts to socioeconomics in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.9.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 10.2.9-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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 socioeconomics addressed in this section are presented as a range of possible impacts.

10.2.9.3. *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 Revenues;
- 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.

Table 10.2.9-1: Impact Significance Rating Criteria for Socioeconomics

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 potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts 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.	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 potentially significant, but with mitigation is less than significant.	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.	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
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	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.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	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 potentially significant, but with mitigation is less than significant.	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.	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

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 Missouri. Median values of owner-occupied housing units in the 2009–2013 period ranged from nearly $177,000 in the greater Lee’s Summit area, to just over $93,000 in Farmington. 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 much more 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 radiation. 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 Revenues

Developing the NPSBN may increase economic activity as governments and partners 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 users 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. 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 partners 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 is a 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 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 gains would be considered positive and less than significant. However, even small employment games 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 Missouri. The average annual unemployment rate in 2014 was 6.1 percent, similar to the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state, including most of the counties around the top 10 population concentrations. The highest unemployment rates were generally in the counties located in the south-central and southeastern portions of the state.

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 10.2.9-1 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.

10.2.9.4. *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 they 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 10.2.9-1.

Activities Likely to Have No Impacts

- 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 to socioeconomic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below summarizes how the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater 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.
    - 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.
    - 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.
    - 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 nearshore and 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.
    - 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.
  - 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.
  - 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.
  - 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.
    - 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.

    - 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.
    - 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., parked vehicles in new parking lots), equipment maintenance activities at such facilities may generate noise, 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.
    - 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.
    - 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.

- 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. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 given the temporary and small-scale nature of the deployment. 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.

Operation Impacts

Activities with the Potential to Have 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. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. All operational activities would be conducted by public or private sector employees, 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.
- 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 are also potential concerns 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 are expected to be less than significant given the temporary and small-scale nature of the deployment. 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 19, may be implemented as appropriate to further minimize potential impacts.

10.2.9.5. *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, but important at a larger scale, although less than significant based on the significance criteria table.

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. The potential adverse impacts of new wireless communication towers on property values would be avoided under the Deployable Technologies Alternative. 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 19, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and while small individually, would be important at a larger scale, although less than significant.

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 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. 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 19, may be implemented as appropriate to further 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. As a result, there would be no impacts to socioeconomics from deployment and operation of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 10.1.9, Socioeconomics.

10.2.10. Environmental Justice

10.2.10.1. *Introduction*

This section describes potential impacts to environmental justice in Missouri 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 19, may be implemented as appropriate to further minimize potential impacts.

10.2.10.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 10.2.10-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed 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.

10.2.10.3. *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, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, 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 Section 10.2.9 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. 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.

Table 10.2.10-1: Impact Significance Rating Criteria for Environmental Justice

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 adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	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.	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

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.

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.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Figure 10.1.10-1) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 10.1.10.3, Environmental Setting: Minority and Low-Income Populations, Missouri has slightly lower percentages of most minorities than the Central region or the nation. The state's poverty rate is similar to that of the nation and higher than that of the region. Missouri has many areas with high and moderate potential for environmental justice populations. The distribution of these high and moderate potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. Further analysis using the data developed for the screening analysis in Section 10.1.10.4, 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, 2015f; USEPA, 2016h).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts can use the evaluation presented below under "Activities with the Potential to Have Impacts" 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.

10.2.10.4. ***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 Proposed 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 depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 on 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 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 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 environmental justice communities, it is anticipated that this activity would have no impact to environmental justice issues.

Activities with the Potential to Have Impacts

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, 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 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 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 nearshore and 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 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 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 noise 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 and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- o 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 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, 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, 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. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

Activities to Have No 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 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.10.5. *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 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 10.1.10, Environmental Justice.

10.2.11. Cultural Resources

10.2.11.1. *Introduction*

This section describes potential impacts to cultural resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.11.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 10.2.11-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed 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 10.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact 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.	Adverse effect 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 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.	Adverse effect 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.	Adverse effect 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.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	Mitigated Adverse Effect[a]	Effect, but Not Adverse	No Effect
	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.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect 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 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 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 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.

10.2.11.3. *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 10.2.11-1, direct deployment impacts could be potentially significant 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 Missouri, some deployment activities may be in 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize 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 significant impacts 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 impacts 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

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 significant impact 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 impacts to such areas by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

10.2.11.4. *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 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 impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 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 impacts 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 on cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts 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 impact to cultural resources.

Activities with the Potential to Have Impacts

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 development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts 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 nearshore and inland bodies of water could impact cultural resources, as areas of Missouri 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 tend to be associated with bodies of water and have high probabilities for archaeological deposits), 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 Jefferson 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 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 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.

10.2.11.5. *Alternatives Impact 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 Impacts

As explained above, implementation of deployable technologies could result in impacts 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. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 deployment impacts, it is anticipated that there would be effects, but not adverse to historic properties associated with implementation/running of the deployable technology because effects to access or the viewshed could occur, depending on the length of deployment. 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.

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 cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.11, Cultural Resources.

10.2.12. Air Quality

10.2.12.1. *Introduction*

This section describes potential impacts to Missouri's air quality from 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.12.2. *Impact Assessment Methodology and Significance Criteria*

The impacts of the Proposed Action on Missouri's air quality were evaluated using the significance criteria presented in Table 10.2.12-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed Action s that would take place in various landscapes, the potential impacts to Missouri's air quality addressed in this section are presented as a range of possible impacts.

Table 10.2.12-1: Impact Significance Rating Criteria for Air Quality

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	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are de minimis or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

10.2.12.3. *Description of Environmental Concerns*

Increased Air Emissions

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be above and 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 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 Missouri that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone and fine particles are an issue near the major cities of Kansas City and St. Louis (see Section 10.1.12, Air Quality).

Based on the significance criteria presented in Table 10.2.12-1, air emission impacts would likely be less than significant 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 could occur for any of the criteria pollutants within attainment areas in Missouri; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Missouri (Figure 10.1.12-1), FirstNet would try to minimize potential emissions where possible and would recommend the implementation of BMPs, where feasible and practicable, to avoid or minimize potential impacts.

10.2.12.4. *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 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 depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

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 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 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 resources, it is anticipated that this activity would have no impact to those resources.

Activities with Potential Impacts to Air Quality

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 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 nearshore and 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 conducing 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 given the temporary and small-scale nature of the deployment. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.12.5. *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 Alterative 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:

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 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 concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

10.2.13. Noise

10.2.13.1. *Introduction*

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Missouri. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.13.2. *Impact Assessment Methodology and Significance Criteria*

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 10.2.13-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed Action s that would take place in various landscapes, the potential noise impacts to Missouri addressed in this section are presented as a range of possible impacts.

Table 10.2.13-1: Impact Significance Rating Criteria for Noise

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 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.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise 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.

10.2.13.3. *Description of Environmental Concerns*

Increased Noise Levels

The Proposed Action has the potential to generate noise during construction and operation of various equipment used for deployment. These noise levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise could cause impacts on residential areas, or other facilities that are sensitive to noise, 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.

Based on the significance criteria presented in Table 10.2.13-1, noise impacts would likely be less than significant 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 sources be deployed/operated long-term in the same area. Noise levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise 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 concentration and setup of equipment would often occur in populated areas, FirstNet operations would not be able to completely avoid noise impacts due to construction and operations at various receptors.

10.2.13.4. *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 2.1.2, 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 noise 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.

Activities Likely to Have No Impacts

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 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 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 impacts, and therefore would have no noise 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 would be emitted during installment of this equipment. Noise 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 environment.
    - 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 noise resources, it is anticipated that this activity would have no impact to those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise 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 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 high noise 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 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 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 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 nearshore and inland bodies of water could generate noise 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 levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Noise 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 emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise 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. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise 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 impact the local noise environment temporarily.
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise 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, except balloons) generate noise during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise 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. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant given the small scale of likely FirstNet activities. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant and similar to several of the deployment activities related to 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 potential noise 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 impacts could result as explained above.

10.2.13.5. *Alternatives Impact Assessment*

The following section assesses potential noise 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 Alterative 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 impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise 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 have a cumulative impact of potential significance. Several vehicles traveling together could also create short-term noise 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 during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-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, given that these activities are of low-intensity and short duration. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 would likely be deployed to areas with low amounts of existing facilities, so noise impacts would be minimal in these 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 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-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

10.2.14. Climate Change

10.2.14.1. *Introduction*

This section describes potential impacts to climate and climate change-vulnerable resources in Missouri 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.14.2. *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 10.2.14-1. As described in Section 10.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed Action s 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 and Alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action and Alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action and Alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT in 2013 (USEPA, 2015j), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the Proposed Action is more general. 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 10.2.14-1: Impact Significance Rating Criteria for Climate Change

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with Mitigation Measures Incorporated**	**Less Than Significant**	**No Impact**
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	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.		Global 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
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 potentially significant, but with mitigation is less than significant.	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 Available

10.2.14.3. *Projected Future Climate*

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high). By mid-century under a high emissions scenario, the total number of hottest days (days above 95 ºF) is projected to increase by mid-century (2041 – 2070) as compared to a 1971 – 2000 baseline in the Midwest with the number of hottest days increasing by more than 25 days per year in Missouri depending on the region of the state. Additionally, much of the Midwest is projected to observe an increase in cooling degree days by mid-century as compared to a 1971 – 2000 baseline, where cooling degree days are defined as the number of degrees that a day's average temperature is above 65°F, which generally leads to an increase in energy use for air conditioning. In Missouri, the cooling degree days under a high emissions scenario are expected to increase more than 375 cooling degree days longer than the baseline years in some areas of the state. (USGCRP, 2014a)

Air Temperature

Figure 10.2.14-1 and Figure 10.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Missouri from a 1969 to 1971 baseline.

Cfa – Figure 10.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Missouri under a low emissions scenario would increase by approximately 4 °F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Missouri would increase by approximately 6 °F. (USGCRP, 2009a)

Figure 10.2.14-2 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 Missouri, temperatures would increase by approximately 9 °F. (USGCRP, 2009a)

Dfa – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Cfa region under a low emissions scenario. (USGCRP, 2009a)

Under a high emissions scenario, temperatures in the Dfa region are expected to increase at the same rate as the Cfa region by mid-century. By the end of the century under a high emissions scenario temperatures will increase by 9 °F or 10 °F depending on the portion of the region. (USGCRP, 2009a)

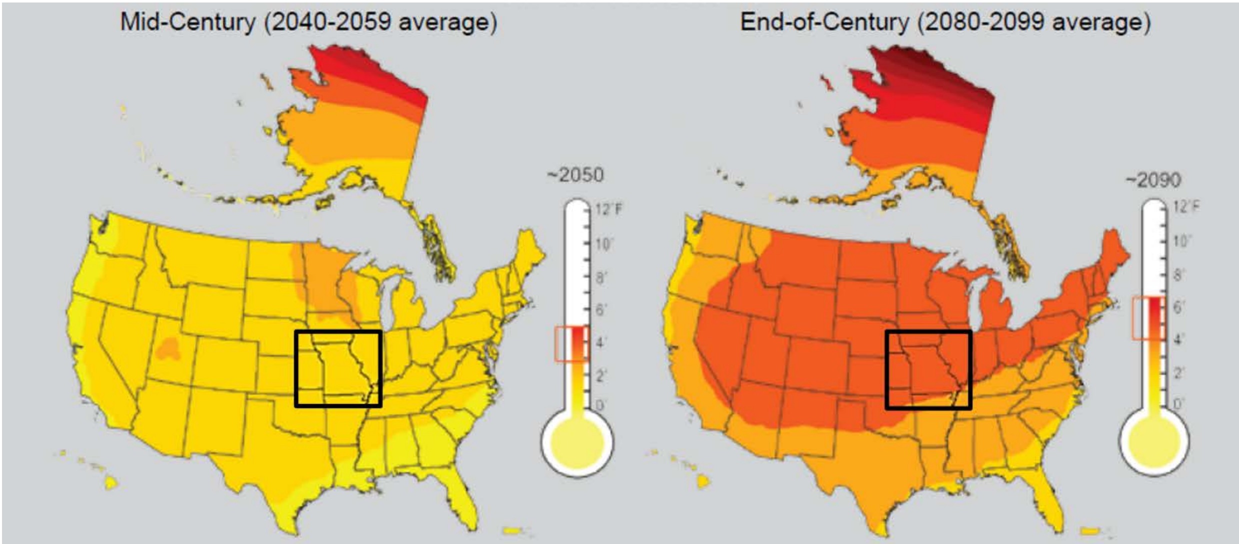

Figure 10.2.14-1: Missouri Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009b)

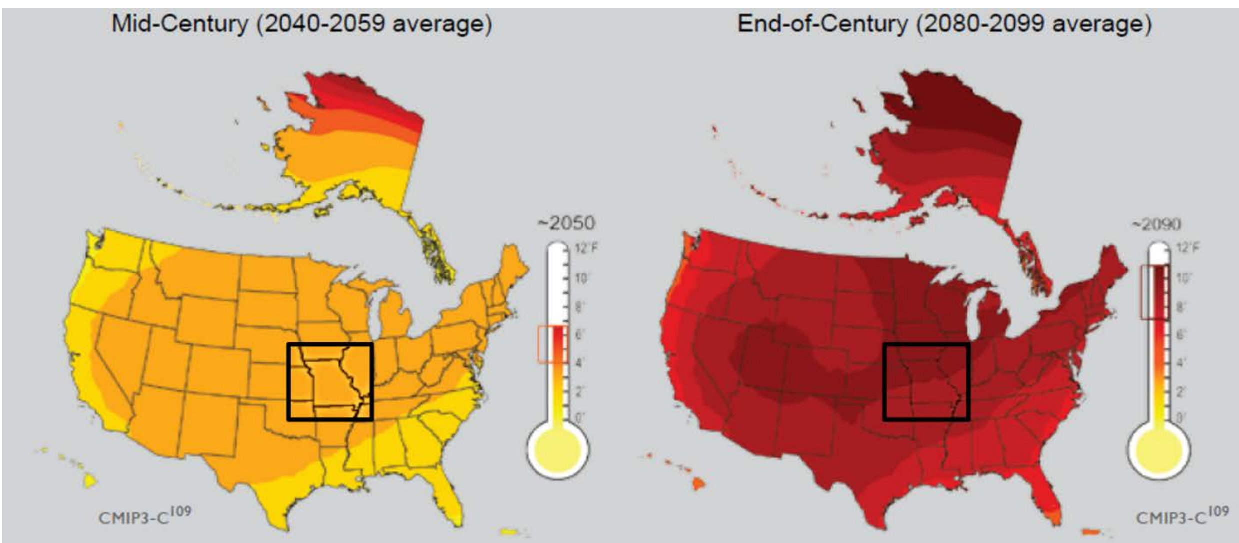

Figure 10.2.14-2: Missouri High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009b)

Precipitation

Precipitation in the Midwest is greatest in the east, declining towards the west. Precipitation occurs about once every seven days in the western part of the region and once every three days in the southeastern part. The 10 rainiest days could contribute as much as 40 percent of total precipitation in a given year. Annual precipitation increased in the Midwest during the past century, with much of the increase driven by intensification of the heaviest rainfalls. This tendency towards more intense precipitation events is projected to continue in the future (USGCRP, 2014a).

Snowfall varies across the region, comprising less than 10 percent of total precipitation in the southern portion of the Midwest, to more than half in the northern portion of the Midwest, with as much as two inches of water available in the snowpack at the beginning of spring melt in the northern reaches of the river basins. When this amount of snowmelt is combined with heavy rainfall, catastrophic, widespread flooding could occur. Trends towards a decline in the frequency of high magnitude snowfall, but an increase in lake effect snowfall have been observed. These divergent trends and their inverse relationships with air temperatures make overall projections of regional impacts of the associated snowmelt extremely difficult. Flooding could also occur due to extreme precipitation in the absence of snowmelt. These warm-season events are also projected to increase in magnitude in the future (USGCRP, 2014a).

In Northern Missouri, there is an expected 10 percent increase in the number of consecutive dry days while in Southern Missouri, there is an expected 20 percent increase in the number of consecutive dry days under a high emissions scenario by mid-century (2041 to 2070) as compared to the period (1971 – 2000). An increase in consecutive dry days could lead to drought (USGCRP, 2014b). Figure 10.2.14-3 and Figure 10.2.14-4 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 10.2.14-3 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 10.2.14-4 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)

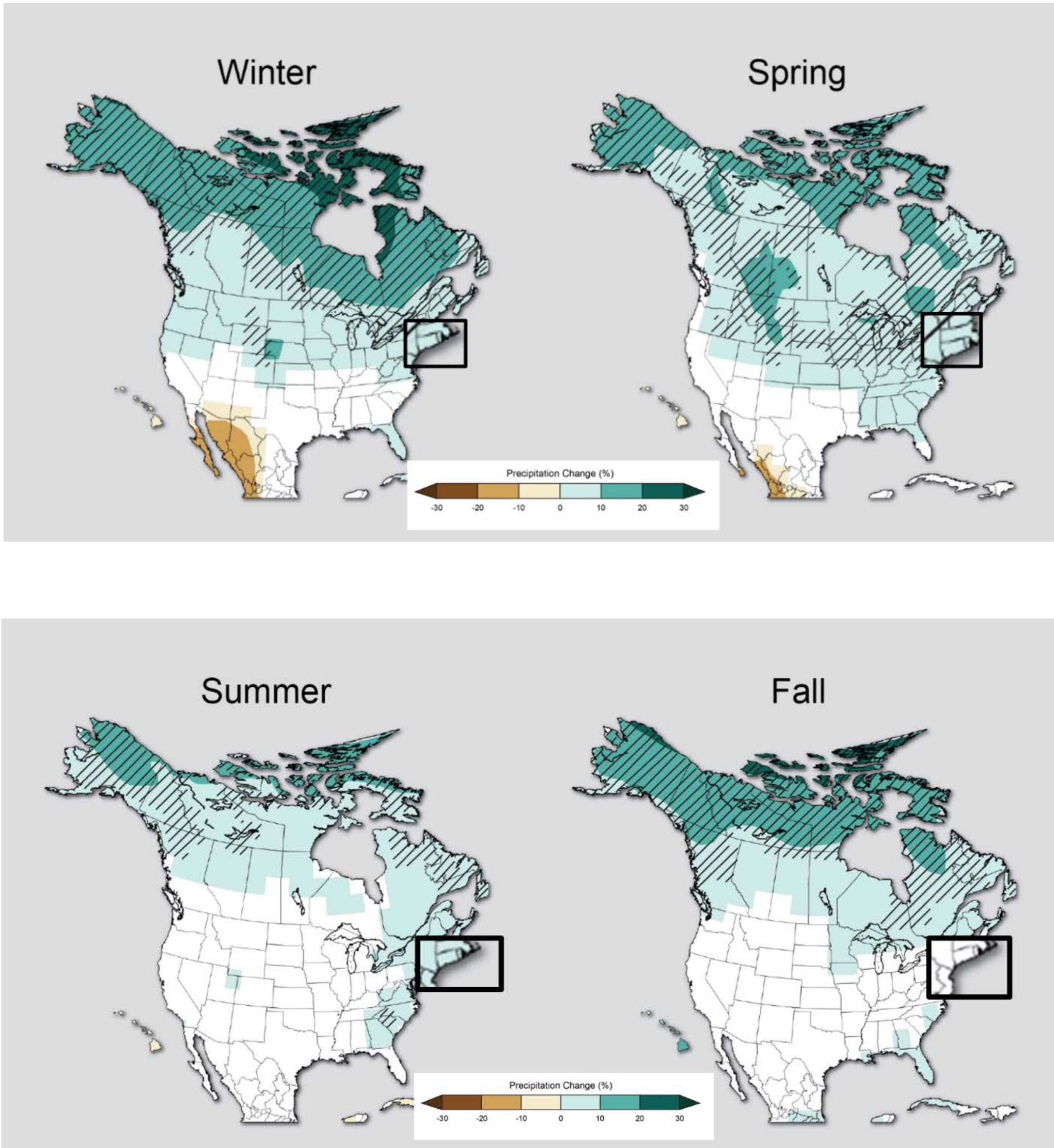

Figure 10.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014b)

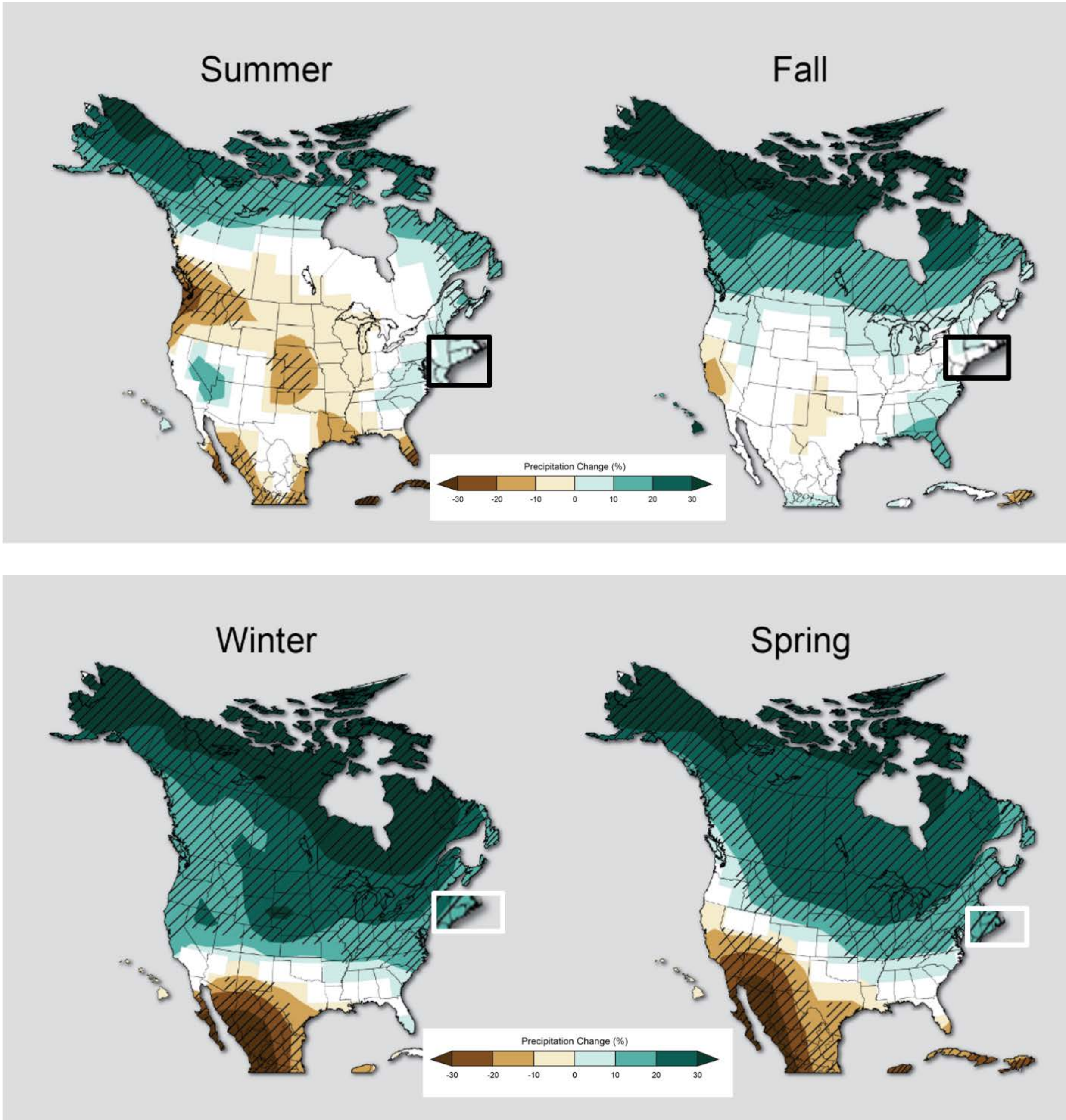

Figure 10.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014b)

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as thunderstorms and hurricanes. Trends in thunderstorms and hurricanes 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 such as hurricanes. 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).

United States coastal waters are expected to experience more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of storms that make landfall) (USGCRP, 2014c). Changes in hurricane intensity are difficult to project because there are contradictory effects at work. Warmer oceans increase storm strength with higher winds and increased precipitation. However, changes in wind speed and direction with height are also projected to increase in some regions; this tends inhibit storm formation and growth. Current research suggests stronger, more rain-producing tropical storms and hurricanes are generally more likely, though such storms may form less frequently; ultimately, more research would likely provide greater certainty (USGCRP, 2009a).

10.2.14.4. *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 CO_2 emissions from fossil fuels.

Based on the impact significance criteria presented in Table 10.2.14-1, 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 of 25,000 MT/year or more. 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.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015g). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO_2 per year.

However, grid-provided electricity would result in less CO_2 emissions than on-site provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015k), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50, 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Project-Related Resource Effects

Climate change may impact project-related effects 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. Climate change may expose areas of Missouri to increased intensity and duration of heat waves (USGCRP, 2014c) particularly in large population centers with the significant urban heat islands such as St. Louis that could greatly magnify these effects, increasing the morbidity and mortality associated with these events (USGCRP, 2014a). Warming temperatures may benefit certain agricultural crops, but may negatively impact key species of trees, altering forest composition with cascading effects on other species (USGCRP, 2014a). Climate change is also expected to raise the temperature of lakes, rivers, and other water bodies, making them more vulnerable to harmful algal blooms and other types of biological contamination, particularly when combined with extreme rainfall events (USEPA, 2015l).

Impact of Climate Change on FirstNet Installations and Infrastructure

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. Based on the impact significance criteria presented in Table 10.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities. For areas of Missouri at risk for flooding, 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). This could negatively impact FirstNet infrastructure as well as magnify the extent and gravity of flood-related disasters. Extended periods of extreme heat may increase general demand on the electric grid, impede the operation of the grid in the Midwest region (DOE, 2013), and overwhelm the capacity onsite equipment needed to keep microwave and other transmitters cool.

10.2.14.5. *Potential Impacts of the Preferred Alternative*

Greenhouse Gas Emissions

The following section assesses potential GHG emission impacts associated with implementation of the Preferred Alternative in Missouri, 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 depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action, 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
  - 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 of these activities.

Activities with the Potential to Have Impacts

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 construction would not take place. 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 in excess of 25,000 MT 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 significant if large numbers of piloted or unmanned 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. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Land use emissions occur as a result of soil disturbance and loss of vegetation. Impacts are expected to be less than significant. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

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. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting from the project, while adaptation refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

10.2.14.6. *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.

Potential 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 based on the defined significance criteria, since activities would be temporary and short-term.

Potential 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 an insignificant 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. 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 deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The concentrations and associated impacts would be dictated by the products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. Climate change effects have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology if the technologies are deployed within a short period of time (less than a decade). However, if these technologies are deployed continuously (at the required location) for a time period greater than a decade, climate change effects on infrastructure could be similar to the Proposed Action, as explained above.

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 GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.14, Climate Change.

10.2.15. Human Health and Safety

10.2.15.1. *Introduction*

This section describes potential impacts to human health and safety in Missouri associated with deployment 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.15.2. *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 10.2.15-1. The categories of impacts are defined as potentially significant, less than significant with mitigation 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 Proposed Action s 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 10.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

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 (TWAs). 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 potentially significant, but with mitigation is less than significant.	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.	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 general 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 potentially significant, but with mitigation is less than significant.	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.	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 Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general 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 potentially significant, but with mitigation is less than significant.	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.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event	NA

NA = Not Applicable

10.2.15.3. *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 are inherently dangerous. 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 10.2.15-1, 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 of chemical hazard extends beyond the restricted access of proposed FirstNet work sites. For example, if fuel is spilled from an onsite fuel tank, the spilled fuel could migrate down gradient and infiltrate underground drinking water sources. The general public may then be exposed to hazardous chemicals in their drinking water if they utilize the same groundwater aquifer.

To protect occupational workers, 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, 2015b).

1.) Engineering controls;

2.) Work practice controls;

3.) Administrative controls; and

4.) 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[159], 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

[159] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016b)

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 employer specific workplace rules and operational practices (OSHA, 2015b). To the extent practicable, FirstNet 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 SDSs, standard operating procedures (SOP) 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 (OSHA, 2015b). 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.

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 as a result of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 10.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned or active 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 Missouri Department of Natural Resources – Division of Environmental Quality (DEQ), 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 Missouri state laws in order to protect workers and the general 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 Missouri DEQ may require FirstNet to perform environmental clean-up Proposed Action s at the site to lower the existing levels of contamination. HHRAs help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRAs 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

FirstNet is intended to improve connectivity among public safety entities during disasters, thereby improving their ability to respond more safely and effectively during such events. The addition of towers, structures, facilities, equipment, and other deployment activities is expected to allow for expedited responses during 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 10.2.15-1, 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, 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. Therefore, FirstNet partner(s) would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

10.2.15.4. *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 2.1.2, 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 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.

Activities Likely to Have No Impacts

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 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 on 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 to those resources.

Activities with the Potential to Have Impacts

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 ROWs, 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 ROWs. 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 nearshore and inland 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 shore 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.

- 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 not result in impacts to soils. 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, Radio Frequency Emissions. 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 dangerous environments (road ROWs, work over water, historic 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 this infrastructure could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure to hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. 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 due to the small scale of likely FirstNet activities that would be temporary and of short duration. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, 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. 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 due to the small scale of likely FirstNet activities that would be temporary and of short duration. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

10.2.15.5. *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 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 is an electrical generator, then there would also be a need to manage hazardous materials (fuel) onsite. These activities could result in less than significant impacts 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 due to the small scale of likely FirstNet activities that would be temporary and of short duration. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures may 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 because of the small scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further 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 human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 10.1.15, Human Health and Safety.

MO APPENDIX A – COMMUNITIES OF CONCERN

Table A-1: S1 Ranked Terrestrial Communities of Concern in Missouri

Vegetative Community Type	EPA Ecoregion(s)	Description	Distribution
Dry-Mesic Sand Forest	Mississippi Alluvial Plain and Mississippi Valley Loess Plain	A mixed oak hardwood community occurring on ridges, knolls, and other well drained uplands.	Limited to southeastern Missouri
Mesic Sand Forest	Mississippi Alluvial Plain and Mississippi Valley Loess Plain	A closed canopy forest occurring on unglaciated slopes and terraces with well drained soils.	Limited to southeastern Missouri
Dry Sand Woodland	Unknown	A mixed oak hardwood community adapted to dry conditions occurring on alluvial sand deposits.	Unknown
Bottomland Flatwoods	Mississippi Alluvial Plain and Mississippi Valley Loess Plain	A bottomland forest community characterized by poorly drained soils and a fluctuating seasonal water table.	Limited to southeast Missouri
Wet-Mesic Bottomland Woodland	Unknown	Undefined	Unknown
Dry-Mesic Loess/Glacial Till Savanna	Ozark Highlands	A fire adapted savanna community of grasses and variable tree cover often occurring on well drained upland soils.	Limited to the Ozark region
Sand Savanna	Mississippi Valley Loess Plain	A sparse woodland savanna community composed of hardwood species adapted to dry conditions, and often occurring on sandstone ridges.	Limited to southeast Missouri
Dry-Mesic Loess/Glacial Till Prairie	Central Irregular Plains and Western Corn Belt Plains	A tall grass prairie community restricted to slopes and hill crests, and occurring on well drained glacial till or outwash.	Limited to northern Missouri
Mesic Loess/Glacial Till Prairie	Central Irregular Plains and Western Corn Belt Plains	A tall grass prairie community commonly occurring on flat to gently rolling loess plains.	Limited to northern Missouri
Dry-Mesic Sandstone/Shale Prairie	Ozark Highlands	A community of prairie grasses and herbs characterized by areas of exposed soil or rock, and occurring on thin soils derived from sandstone or shale.	Limited to southwestern Missouri
Sand Prairie	Ozark Highlands	A community dominated by prairie grasses often occurring on sandy ridges or alluvial sand deposits	Limited to southwestern Missouri

Vegetative Community Type	EPA Ecoregion(s)	Description	Distribution
Wet-Mesic Bottomland Prairie	Unknown	A prairie community typically occurring on the floodplains of streams and rivers where the water table is high in the soil profile.	Unknown
Wet Bottomland Prairie	Unknown	Undefined	Unknown
Swamp	Unknown	Undefined	Unknown
Pond Marsh	Mississippi Alluvial Plain and Mississippi Valley Loess Plain	Wetland plant community with fluctuating water levels often occurring in sinkhole depressions or depressions of terraces	Limited to southeast Missouri
Pond Swamp	Mississippi Alluvial Plain and Mississippi Valley Loess Plain	A wetland plant community occurring in natural depressions with water levels often diminishing seasonally.	Limited to southeastern Missouri
Glacial Fen	Unknown	Undefined	Unknown
Saline Seep	Ozark Highlands and Central Irregular Plains	A herbaceous plant community dependent on periodic influx of saline water and often occurs in floodplains	Limited to western Missouri

Sources: (EPA 2015g; MDC 2015c; The Nature Conservancy 2001)

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AIRFA	American Indian Religious Freedom Act
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CCD	Common Core of Data
CCR	Consumer Confidence Reports
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH_4	Methane
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
CWS	Community Water Systems
DEQ	Division of Environmental Quality
DNR	Department of Natural Resources
DOE	Department of Energy
DPS	Department of Public Safety
EDACS	Enhanced Digital Access System
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
EPHT	Environmental Public Health Tracking
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee

Acronym	Definition
FHWA	Federal Highways Administration
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
FR	Federal Register
FRA	Federal Railway Administration
FTA	Federal Transit Authority
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accountability Office
GAP	Gap Analysis Program
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	International Birding Area
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Regions
LTE	Long Term Evolution
MARRS	Metro Regional Radio System
MBTA	Migratory Bird Treaty Act
MDA	Missouri Department of Agriculture
MDC	Missouri Department of Conservation
MDEQ	Missouri Division of Environmental Quality
MDHSS	Missouri Department of Health and Senior Services
MDI	Methylene Diphenyl Diisocyanate
MDNR	Missouri Department of Natural Resources
MDOL	Missouri Department of Labor
MHI	Median Household Income
MLRA	Major Land Resource Areas
MNHP	Missouri Natural Heritage Program
MO	Missouri
MOA	Memorandum of Agreement
MOSWIN	Missouri Statewide Interoperability Network
MMT	Million Metric Tons
MPSC	Missouri Public Service Commission
MSFCMA	Magnuson-Stevens Fisheries Conservation Management Act
MSL	Mean Sea Level
MT	Million Tons
MYA	Million Years Ago
N_2O	Nitrous Oxide
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NEPA	National Environmental Policy Act

Acronym	Definition
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institute of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NMSZ	New Madrid Seismic Zone
NNL	National Natural Landmarks
NOAA	National Oceanic and Atmospheric Administration
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
NTIA	National Telecommunications and Information Administration
NTFI	National Task Force On Interoperability
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
NWR	National Wildlife Refuges
NWS	National Weather Service
OCIO	Office of the CIO
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
ORION	Omaha Regional Interop Network
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PAB	Palustrine Aquatic Bed
PCN	Preconstruction Notification
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
PGA	Peak Ground Acceleration
PM	Particulate Matter
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetland
PUB	Palustrine Unconsolidated Bottom
R&D	Research and Development
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
ROW	Right-of-Way

Acronym	Definition
SAA	Sense and Avoid
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
STL	St. Louis International Airport
SUA	Special Use Airspace
SEAP	State Wildlife Action Plan
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TNC	Transient Non-Community Systems
TPY	Tons Per Year
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of Interior
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WCS	Wetlands Classification Standard
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

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