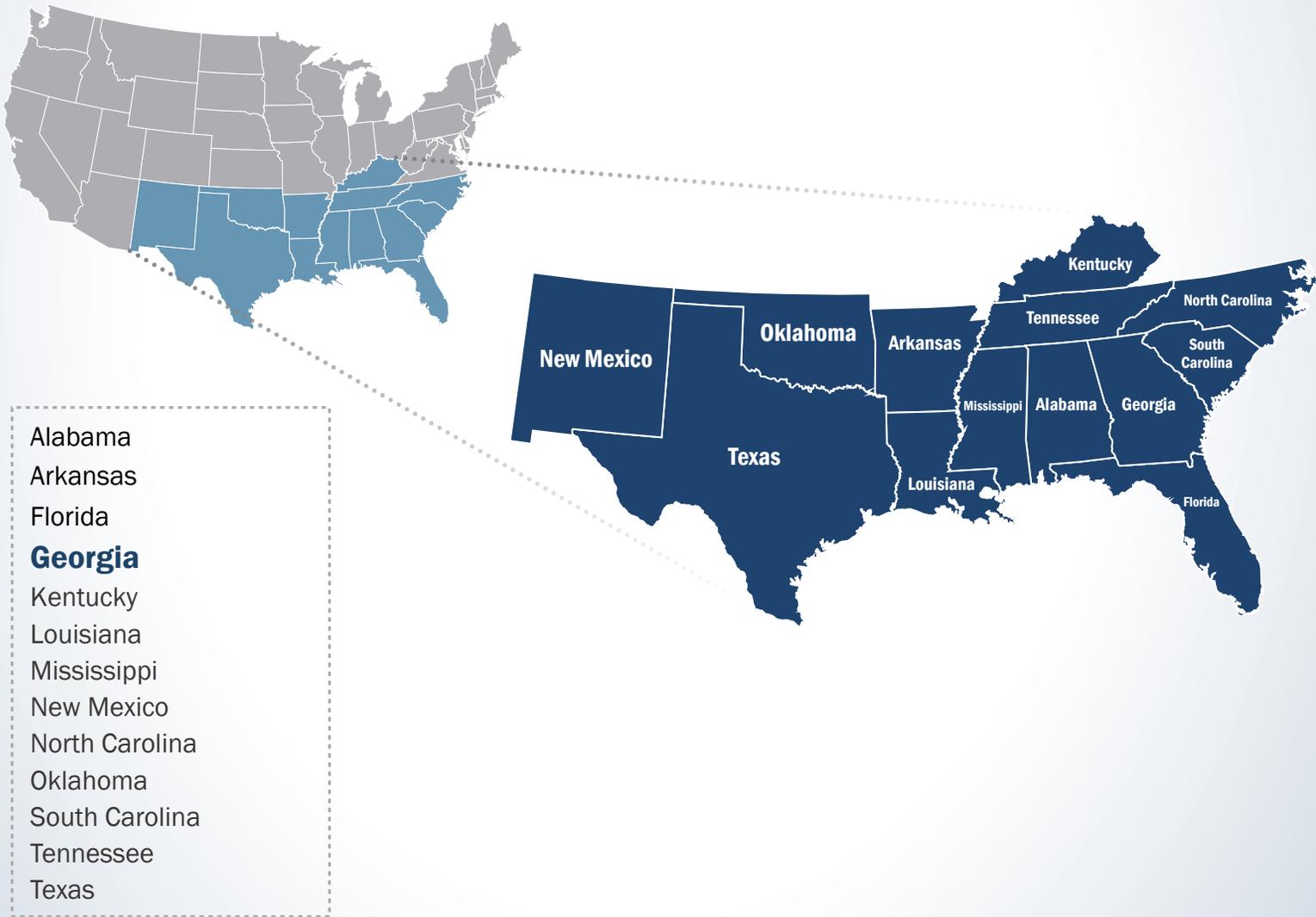




**FirstNet**<sup>®</sup>

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

## **VOLUME 4 - CHAPTER 6**





# First Responder Network Authority



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

### **VOLUME 4 - CHAPTER 6**

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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 Commerce—National Telecommunications and Information Administration  
U.S. Department of Defense—Department of the Air Force  
U.S. Department of Energy  
U.S. Department of Homeland Security

**August 2017**

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## 6. GEORGIA

Georgia was populated for centuries by American Indian tribes with a rich cultural history. The colony of Georgia was founded in 1733 by an Englishman named James Oglethorpe who named the state after the British king on the throne at the time, George II. Georgia was the last of the original 13 colonies to ratify the U.S. Constitution and become a state (State of Georgia, 2015). Georgia is bordered by the Atlantic Ocean and South Carolina to the east, North Carolina and Tennessee to the north, Alabama to the west, and Florida to the south. This chapter provides details about the existing environment of Georgia as it relates to the Proposed Action.



General facts about Georgia are provided below:

- **State Nickname:** The Peach State
- **Area:** 57,513.49 square miles; **U.S. Rank:** 21 (U.S. Census Bureau, 2015a)
- **Capital:** Atlanta
- **Counties:** 159 (U.S. Census Bureau, 2015b)
- **2014 Estimated Population:** 10,097,343; **U.S. Rank:** 8 (U.S. Census Bureau, 2015a)
- **Most Populated Cities:** Atlanta, Augusta-Richmond County, Savannah, and Columbus (U.S. Census Bureau, 2015b)
- **Main Rivers:** Altamaha, Chattahoochee, Coosa, Flint, Ochlockonee, Ocmulgee, Oconee, Ogeechee, St. Marys, Satilla, Savannah, Suwannee, Tallapoosa, and Tennessee Rivers
- **Bordering Waterbodies:** Chattahoochee River and Savannah River
- **Mountain Ranges:** A portion of the Blue Ridge Mountains, a portion of the Appalachian Mountains, and the Cohutta Mountains
- **Highest Point:** Brasstown Bald (4,784 ft.) (USGS, 2015a)

## **6.1. AFFECTED ENVIRONMENT**

### **6.1.1. Infrastructure**

#### ***6.1.1.1. Definition of the Resource***

This section provides information on key Georgia infrastructure resources that could potentially be affected by FirstNet projects. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, 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 6.1.1.3 provides an overview of Georgia’s traffic and transportation infrastructure, including road and rail networks and waterway facilities. Georgia’s public safety infrastructure could include any infrastructure utilized by a public safety entity<sup>1</sup> 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 Georgia are presented in more detail in Section 6.1.1.4. Section 6.1.1.5 describes Georgia’s public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Georgia’s utilities, such as power, water, and sewer, is presented in Section 6.1.1.6.

#### ***6.1.1.2. Specific Regulatory Considerations***

Multiple Georgia laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 6.1.1-1 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.

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<sup>1</sup> The term “public safety entity” means an entity that provides public safety services (7 U.S. Code [U.S.C.] § 1401(26)).

**Table 6.1.1-1: Relevant Georgia Infrastructure Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Code of Georgia: Title 46 Public Utilities and Public Transportation; Title 50 State Government: Rules and Regulations of the State of Georgia: Department 515 Georgia Public Service Commission	Georgia Public Service Commission (PSC)	Develops a state plan for residential energy conservation; enters into agreements to carry out energy related research and planning jointly with other states or the federal government; prepares a standby emergency plan setting forth actions to be taken in the event of an energy shortage; implements programs to encourage energy conservation and efficiency; conducts hearing and investigates into public utilities; assures the most efficient, economical, and orderly rendering of retail electric service within the state.
Rules and Regulations of the State of Georgia: Department 266 Georgia Emergency Management Agency; Department 511 Department of Public Health	Georgia Emergency Management Agency (GEMA); Georgia Department of Public Health (GADPH)	Works to ensure the preparations of the state are adequate to deal with emergencies; provides for the rendering of mutual aid among political subdivisions with respect to carrying out emergency management functions; prepares a comprehensive plan and program for emergency management; works to reduce response times of emergency services personnel.
Code of Georgia: Title 6 Aviation; Title 46 Public Utilities and Public Transportation; Title 40 Motor Vehicles and Traffic	State Transportation Board; Georgia Department of Transportation (GADOT); GADPH	Performs inspections of railroads; plans for the establishment, development, and maintenance of aviation and aviation facilities, including airports; provides for the organization, administration, and operation of an efficient system of public roads and other modes of transportation; plans, designates, improves, manages, controls, constructs, and maintains a state highway system.

Source: (Code of Georgia, 2017a) (GA R&R, 2017a) (GA R&R, 2017b) (GA R&R, 2017c) (Code of Georgia, 2017b) (Code of Georgia, 2017c)

**6.1.1.3. Transportation**

This section describes the transportation infrastructure in Georgia, including specific information related to the road networks, airport facilities, rail networks, harbors (this Programmatic Environmental Impact Statement [PEIS] defines “harbors” as a body of water deep enough to allow anchorage of a ship or boat), and ports. 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 Georgia are based on a review of maps, aerial photography, and federal and state data sources.

GADOT has jurisdiction over freeways and major roads, airports, railroads, mass transit, and ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the GADOT is to “provide a safe, connected, and environmentally sensitive transportation system that enhances Georgia’s economic competitiveness by working efficiently and communicating effectively to create strong partnerships” (GADOT, 2015a).

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

- 128,620 miles of public roads (FHWA, 2014) and 14,620 bridges (FHWA, 2015a);
- 4,649 miles of rail network that includes passenger rail and freight (GADOT, 2015b);
- 465 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 47 harbors (U.S. Harbors, 2015); and
- 2 major ports that includes both public and private facilities.

**Road Networks**

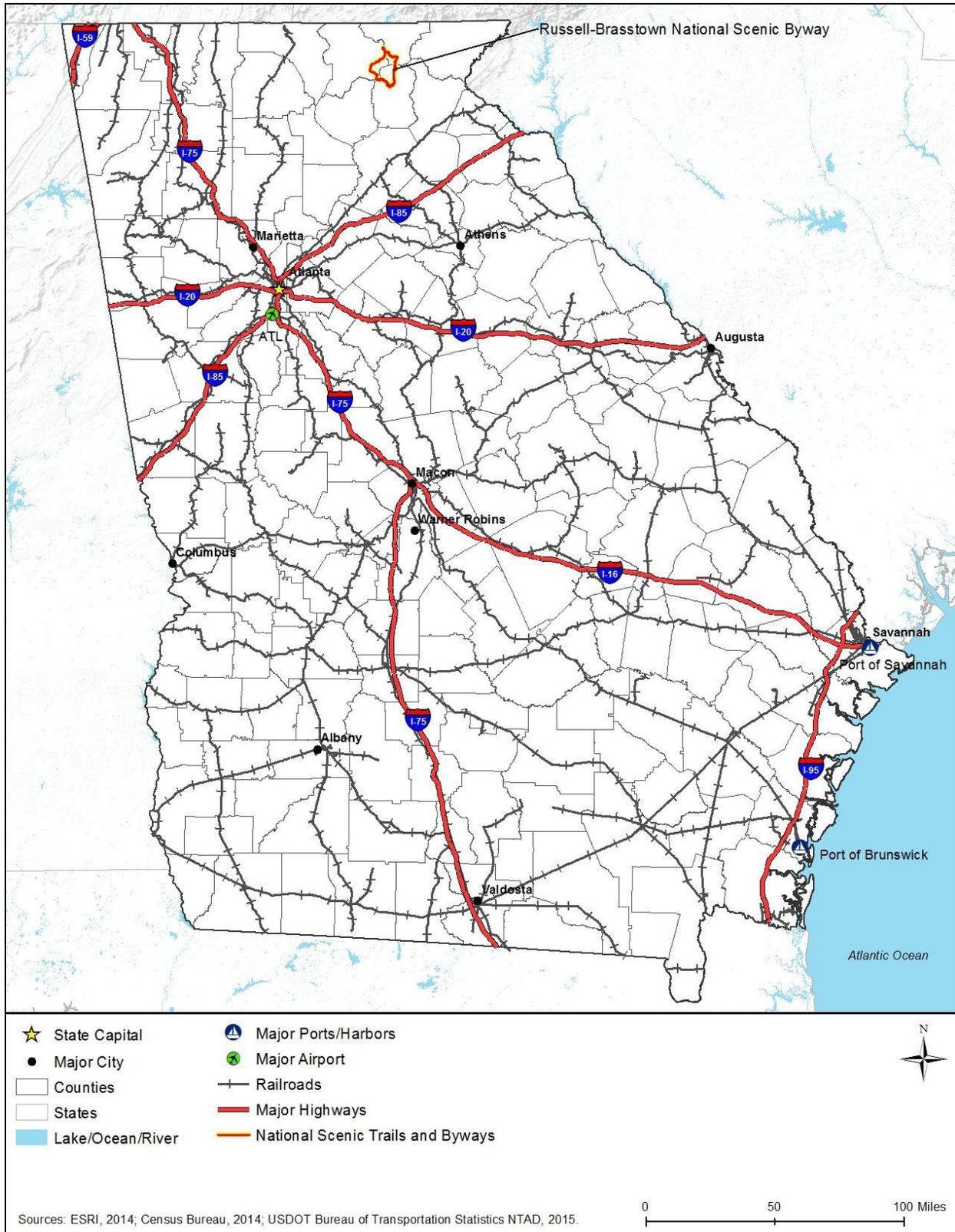
As identified in Figure 6.1.1-1, the major urban centers of the state from north to south are Marietta, Athens, Atlanta, Augusta, Macon, Warner Robins, Columbus, Savannah, Albany, and Valdosta (USDOD, 2013a). Georgia has seven major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 6.1.1-2 lists the interstates and their start/end points in Georgia. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

**Table 6.1.1-2: Georgia Interstates**

Interstate	Southern or western terminus in GA	Northern or eastern terminus in GA
I-16	I-75 in Macon	Montgomery Street in Savannah
I-20	AL line near Tallapoosa	SC line at Augusta
I-24	TN line at Trenton	TN line at Wildwood
I-59	AL line at Rising Fawn	I-24 at Trenton
I-75	FL line near Lake Park	TN line near Graysville
I-85	AL line near West Point	SC line near Gumlog
I-95	FL line at Kingsland	SC line at Rincon

Source: (FHWA, 2015b)

In addition to the Interstate System, Georgia 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 (FHWA, 2013). Figure 6.1.1-1 illustrates the major transportation networks, including roadways, in Georgia. Section 6.1.8, Visual Resources, describes the National and State Scenic Byways found in Georgia from an aesthetic perspective.



**Figure 6.1.1-1: Georgia Transportation Networks**

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 (FHWA). Georgia has one National Scenic Byway:

- Russell-Brasstown National Scenic Byway (FHWA, 2015c).

State Scenic Byways are roads with statewide interest and are designated and managed by GADOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Georgia has 14 State Scenic Byways that crisscross the entire state (GADOT, 2015c):<sup>2</sup>

- Altamaha Historic Scenic Byway
- Cohutta-Chattahoochee Scenic Byway
- Enduring Farmlands Scenic Byway
- Historic Dixie Highway
- Historic Effingham-Ebenezer Scenic Byway
- Historic Piedmont Scenic Byway
- I-185 Scenic Byway
- Meriwether-Pike Scenic Byway
- Millen-Jenkins Scenic Byway
- Monticello Crossroads Scenic Byway
- Ocmulgee-Piedmont Scenic Byway
- Ridge and Valley Scenic Byway
- South Fulton Scenic Byway
- Warren County-Piedmont Scenic Byway

## Airports

Air service to the state is provided by a major international airport: the Hartsfield-Jackson Atlanta International Airport (ATL). The airport is owned and operated by the City of Atlanta's Department of Aviation and it is located 10 miles from downtown Atlanta (Atlanta International Airport, 2014a). The airport serves over 250,000 passengers and about 2,500 arrivals and departures every day (Atlanta International Airport, 2014a). Therefore, not only has ATL been the busiest passenger airport in the world since 1998, but it has also been the busiest operations airport in the world since 2005 (Atlanta International Airport, 2014a). In 2014, ATL served 96,178,899 passengers, facilitated 868,359 aircraft operations, and handled 601,270 metric tons of cargo (Atlanta International Airport, 2014b). ATL's air traffic control tower is the tallest in North America, at 398 feet, which also makes it the fourth tallest in the world (Atlanta International Airport, 2014a). Figure 6.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 6.1.7.5, Airspace, provides greater detail on airports and airspace in Georgia.

## Rail Networks

Georgia is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 6.1.1-1 illustrates the major transportation networks, including rail lines, in Georgia.

Amtrak runs two lines through Georgia: the Crescent and Silver Service/Palmetto. In 2013, Amtrak served 192,000 passengers at Georgia's five Amtrak stations; with 99,000 passengers

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

served, the Atlanta Peachtree Street Station is Georgia’s busiest (GADOT, 2015b). Table 6.1.1-3 provides a complete list of Amtrak lines that run through Georgia.

**Table 6.1.1-3: Amtrak Train Routes Serving Georgia**

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Georgia
Crescent	New York, NY	New Orleans, LA	30 hours	Toccoa, Gainesville, Atlanta
Silver Service/Palmetto	New York, NY	Tampa/Miami, FL	28+ hours	Savannah, Jesup

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

The Metropolitan Atlanta Rapid Transit Authority (MARTA) is a commuter rail service that serves the City of Atlanta and its suburbs. MARTA operates four lines, all of which convene in downtown Atlanta at the Five Points Station (USDOT, 2010). MARTA operates 318 trains on 48 miles of track and stops at 38 stations (USDOT, 2010). On an average weekday, MARTA serves 75,500 passengers (MARTA, 2014).

The majority of Georgia’s 4,649 miles of railroad tracks are owned by two Class I freight railroad companies. CSX Transportation and Norfolk Southern Railway own 3,631 route miles in the state (GADOT, 2015b). The other 1,018 miles of track are owned by the state of Georgia or shore line (Class III) railroads (GADOT, 2015b). In 2011, 189 million tons of freight traveled via freight rail in Georgia (GADOT, 2015b).

### Harbors and Ports

Georgia’s east coast borders the Atlantic Ocean, making it ideal for the development of harbors and shipping facilities. Two large deep-water port facilities exist in the cities of Savannah and Brunswick. Each facility (and the involved terminals) is owed by the Georgia Ports Authority (GPA), a state-level authority that oversees port activities. The Port of Savannah is located on the southwest bank of the Savannah River, opposite the Savannah National Wildlife Refuge in South Carolina. The Port of Brunswick is situated around the meeting of Fancy Bluff Creek and the Atlantic in southeast Georgia. Terminals sit on either side of the creek and allow easy access to the ocean. As depicted in Figure 6.1.1-1, both Port facilities can be reached via I-95 (GAPorts, 2015a).

The Port of Savannah is composed of the Garden City Terminal and the Ocean Terminal. Rail access to the terminals is provided by Norfolk Southern and CSX rail lines (GAPorts, 2015b). Since 2014, the GPA has worked to deepen the Savannah River to make a larger harbor and allow larger ships to access the port. The project is intended to deepen the harbor to 47 feet and its entry channel to 49 feet (GAPorts, 2015c). Currently, the harbor itself has a depth of 42 feet. (USACE, 2015a). The Savannah Harbor entry channel has a depth of 44 feet (USACE, 2015b). They also intend to increase the size of the Kings Island Turning Basin located at the Garden City Terminal (GAPorts, 2015c).

The Port of Brunswick contains the Mayor’s Point Terminal and the Colonel’s Island Terminal. Colonel’s Island is contains facilities for the management of both roll on/roll off cargo and bulk agricultural cargo. Brunswick is home to the second busiest roll on/roll off cargo port in the

United States (GAPorts, 2015d). According to data from the United States Census Bureau, both of these port facilities are important for the health of U.S. trade. In 2013, the Port of Savannah was responsible for importing approximately \$43 billion in cargo weighing approximately 13.4 million tons, and exporting \$27.7 billion worth of cargo weighing 17.6 million tons. The facilities at the Port of Brunswick imported \$14 billion in goods weighing 1.2 million tons and exported \$5 billion in goods, weighing 1.9 million tons (U.S. Census Bureau, 2015c).

**6.1.1.4. Public Safety Services**

Georgia 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 6.1.1-4 presents Georgia’s key demographics including population; land area; population density; and number of municipal governments. More information about these demographics is presented in Section 6.1.9, Socioeconomics.

**Table 6.1.1-4: Key Georgia Indicators**

<b>Georgia Indicators</b>	
Estimated Population (2014)	10,097,343
Land Area (square miles) (2010)	57,513.49
Population Density (persons per sq. mile) (2014)	176
Municipal Governments (2013)	535

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

Table 6.1.1-5 presents Georgia’s public safety infrastructure, including fire and police stations. Table 6.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

**Table 6.1.1-5: Public Safety Infrastructure in Georgia by Type**

<b>Infrastructure Type</b>	<b>Number</b>
Fire and Rescue Stations <sup>a</sup>	1,613
Law Enforcement Agencies <sup>b</sup>	1,153
Fire Departments <sup>c</sup>	463

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

<sup>a</sup> Data collected by the U.S. Fire Administration in 2015.

<sup>b</sup> 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.

<sup>c</sup> Data collected by the U.S. Fire Administration in 2015.

**Table 6.1.1-6: First Responder Personnel in Georgia by Type**

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers <sup>a</sup>	3,300
Fire and Rescue Personnel <sup>b</sup>	25,578
Law Enforcement Personnel <sup>c</sup>	72,389
Emergency Medical Technicians and Paramedics <sup>d,e</sup>	9,130

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

<sup>a</sup> BLS Occupation Code: 43-5031.

<sup>b</sup> 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.

<sup>c</sup> 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.

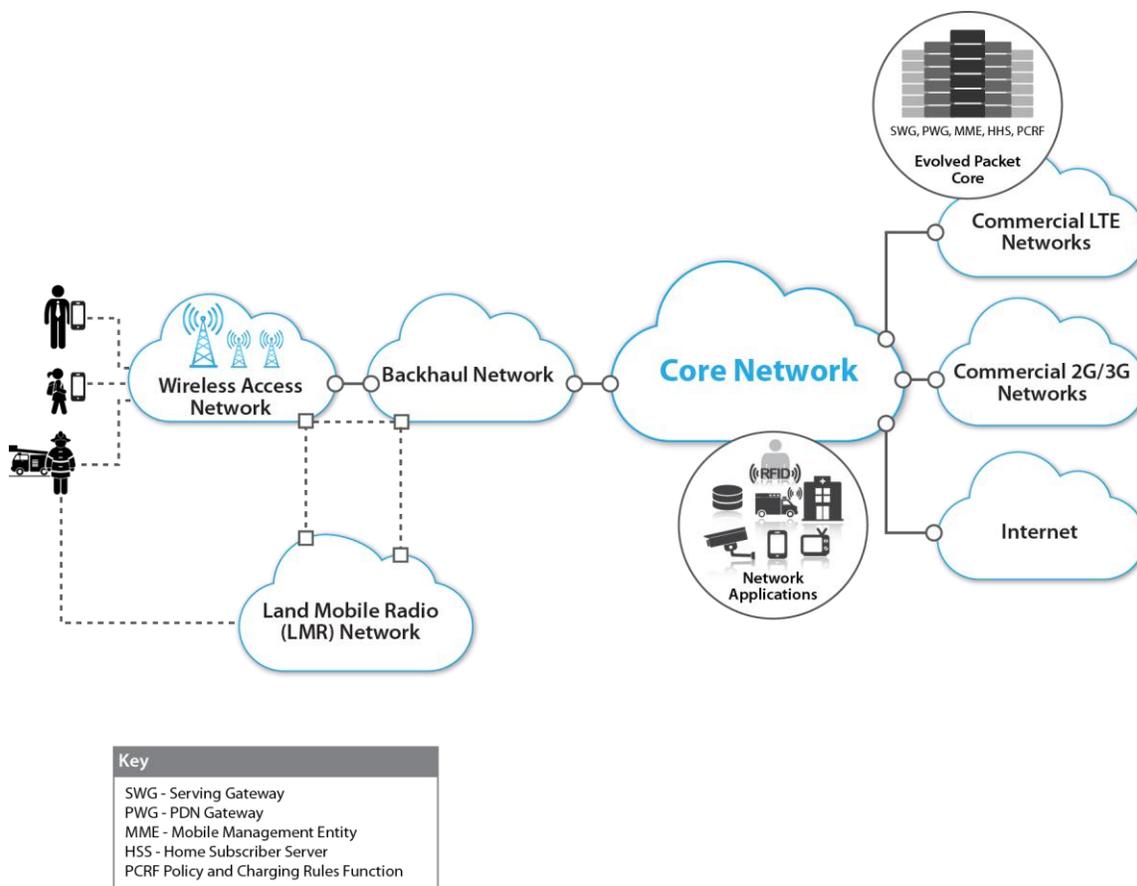
<sup>d</sup> BLS Occupation Code: 29-2041.

<sup>e</sup> All BLS data collected in 2015.

### **6.1.1.5. Telecommunications Resources**

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Georgia; 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, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems providing voice, data, and video services (BLS, 2016). Figure 6.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).



Prepared by: Booz Allen Hamilton

**Figure 6.1.1-2: Wireless Network Configuration**

### Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information, including jurisdictional challenges, funding challenges, the pace of technology evolution, and communication interoperability. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in Georgia.

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 (LMR) networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research Program (PSCR) – Boulder Laboratories, in 2015, 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 (PSCR, 2015).

As the state of Georgia’s Statewide Communication Interoperability Plan (SCIP) acknowledges, the state’s Public safety LMR networks are largely dependent upon Very High Frequency (VHF)<sup>3</sup> systems and are diverse in terms of the use of multiple spectrum bands. “In Georgia, most LMR systems operate in the VHF range. Many of the larger communities use 800 Megahertz (MHz), including the seven regional radio systems. Very few public safety agencies in Georgia use Ultra High Frequency (UHF)<sup>4</sup> however many school systems and other emergency responder support agencies utilize UHF. For neighboring counties with similar systems, the cross-programming of frequencies is the most commonly used method of interoperability. However, as 800 MHz becomes more prevalent, system incompatibility is becoming more common. Due to the costs, terrain and physical size complexities of Georgia, there is no single radio technology that will be the solution in the state for the near future.” (State of Georgia, 2012a)

To address the need for greater interoperability across public safety land mobile radio systems in Georgia, the state has implemented a statewide interoperability gateway system. This system, called the Georgia Interoperability Networks (GIN), is a Radio-Over-Internet Protocol (RoIP)<sup>5</sup> system and as of 2012, the GIN was active at 193 radio sites in Georgia (State of Georgia, 2012a). The Georgia State Patrol (GSP) serves as the GIN system administrator and provides system maintenance to the network (State of Georgia, 2012b). As Georgia’s SCIP confirms, public safety network communications in Georgia reflect a combination of legacy analog VHF, UHF, 700 MHz, and 800 MHz systems operating on multiple frequencies bands. Georgia has committed to increase its advancement along the interoperability continuum through future extension of its GIN which leverages P-25 digital capabilities (State of Georgia, 2012a).

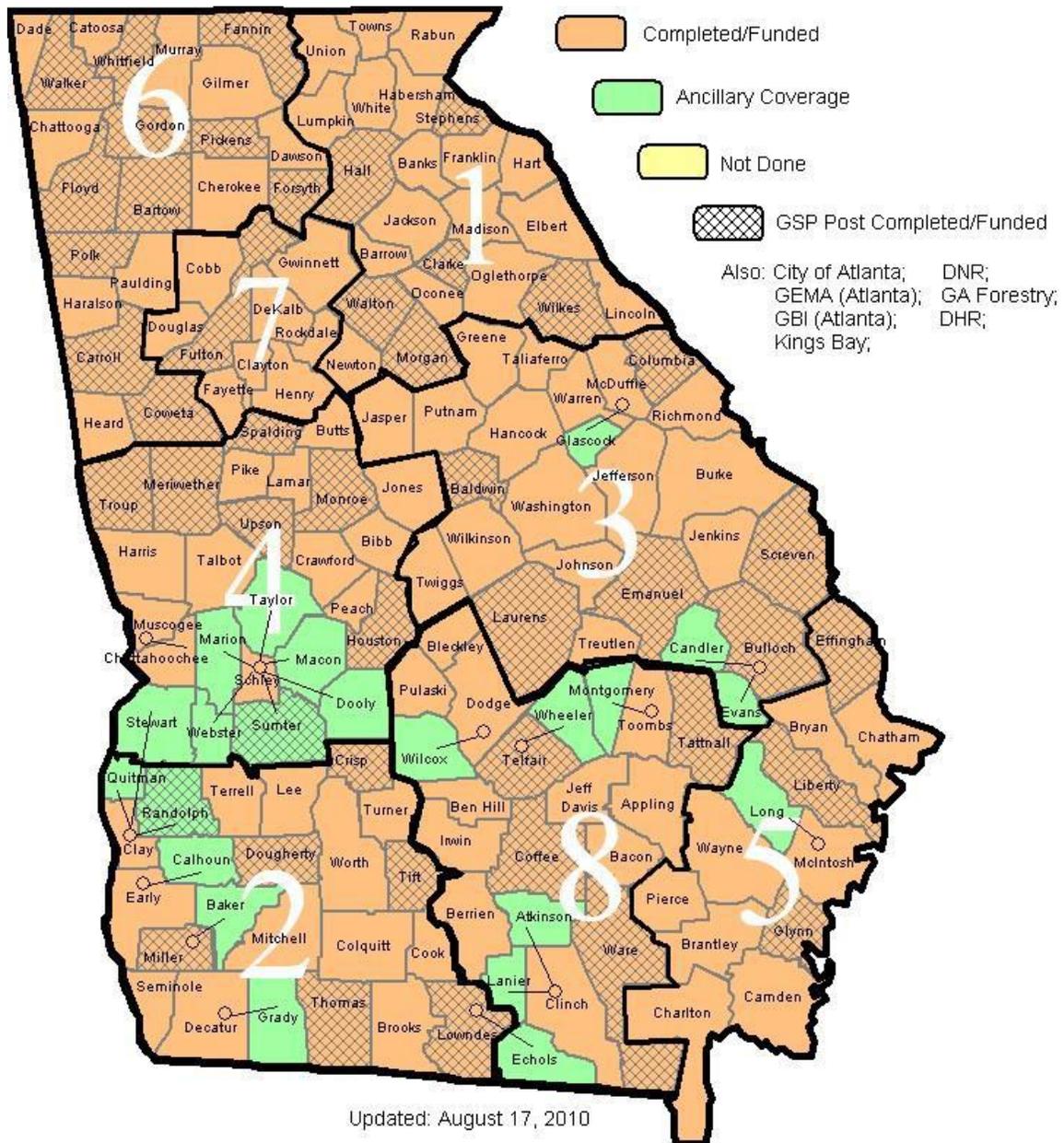
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<sup>3</sup> VHF band covers frequencies ranging from 30 MHz to 300 MHz. (NTIA, 2005)

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

<sup>5</sup> Radio Over Internet Protocol (RoIP) is a methodology for transmitting/receiving over wireless communications via Internet Protocol (IP).

The state of Georgia is organized around eight geographic regions regarding the deployment and management of the GIN as Figure 6.1.1-3 depicts. Figure 6.1.1-3 also highlights Georgia's Department of Public Safety's status<sup>6</sup> of the network's deployment by region and county (GADPS, 2010).



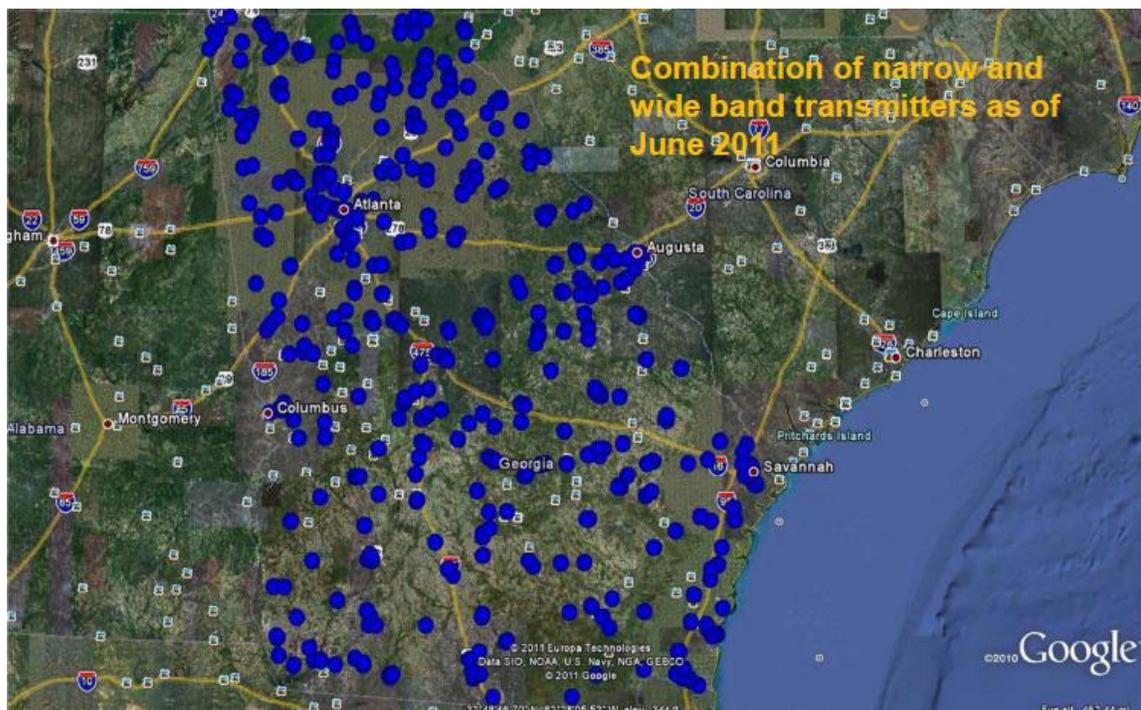
Source: (GADPS, 2010)

**Figure 6.1.1-3: Georgia Interoperable Networks (GIN) System Rollout**

<sup>6</sup> As of August 2010.

### Statewide Public Safety Networks

The GIN is the cornerstone of the state’s Public Safety LMR strategy to deliver improved capabilities and interoperability throughout Georgia (State of Georgia, 2012a). Figure 6.1.1-4 depicts the location of narrowband<sup>7</sup> and wideband transmitters<sup>8</sup> in Georgia<sup>9</sup>, which demonstrate wide dispersion across the state (GEMA, 2011).



Source: (GEMA, 2011)

**Figure 6.1.1-4: Georgia Narrowband and Wideband Transmitter Locations**

The Georgia State Patrol has multiple licensed frequencies on which it operates, including analog loVHF, VHF, and UHF frequencies, and is in process of upgrading to a digital P-25 repeater system (RadioReference.com, 2015a). There is also an interoperable set of two channels in the VHF band providing statewide coverage for sheriffs in Georgia: the Statewide Sheriff’s Network and Statewide Sheriff’s Network Mobile (RadioReference.com, 2015b). In Georgia, the AirEvac Lifestream, medical evacuation helicopters use VHF frequencies for tactical communications, but can communicate to other agencies operating on other VHF, UHF, and 800 MHz frequencies to most city/county EMS and public safety first responders throughout the state (RadioReference.com, 2015c).

<sup>7</sup> The FCC Narrowbanding mandate required that before January 1, 2013, systems operating in the 150 MHz-174 MHz VHF band and those in the 421 MHz-512 MHz band migrate to 12.5 kHz channel size (vs the previous 25 kHz) to produce greater spectral efficiency and thus accommodate increased channels in LMR systems (FCC, 2016b). Narrowband transmitters typically handle channel sizes of 6.25 kHz, 12.5 kHz, and 25 kHz “narrowband” channels.

<sup>8</sup> Wideband is a transmission medium that delivers a wider bandwidth (where bandwidth is wider than one voice channel); this contrast with the “narrower” width of the narrowband frequency regime used in narrowband transmitters.

<sup>9</sup> As of 2011, based on a Georgia Emergency Management Agency (GEMA) presentation at an Elected Officials Communications Forum on emergency communications and narrowbanding.

*City and County Public Safety Networks*

Georgia’s city and county public safety networks serving police, fire, and EMS users are diverse, with a large number of legacy VHF and UHF systems reflecting primarily a mix of legacy analog and a growing number of P-25 digital systems. Table 6.1.1-7 presents a list of P-25 digital systems in Georgia (Project25.org, 2015a) (Project25.org, 2015b).

There are multiple regional multi-county public safety land mobile radio networks in Georgia providing broad geographic coverage and intended to advance the state of interoperability in Georgia. Table 6.1.1-7 summarizes six of the most prominent regional Public Safety LMR systems in Georgia which the state highlighted in its SCIP (State of Georgia, 2012a). All of the profiled LMR systems are digital Phase 1 P-25 systems with the exception of the TVRS 700 MHz/800 MHz system which is a Phase 2 P-25 system (Project25.org, 2015a) (Project25.org, 2015b).

**Table 6.1.1-7: Representative Georgia Regional Land Mobile Radio Systems**

<b>Georgia Regional P25 LMR Systems</b>	<b>City/County Served</b>	<b>Frequency Band</b>
Atlanta Urban Area Security Initiative (UASI)	City of Atlanta, Cobb County, DeKalb County, Fulton County	800 MHz
Western Area Regional Radio System (WARRS)	Carroll County, Coweta County, Haralson County	700 MHz/800 MHz
Southeast Georgia Regional Radio Network (SEGARRN)	Counties of: Bryan, Bulloch, Camden, Chatham, Effingham, Glynn, Liberty	700 MHz/800 MHz
Tennessee Valley Regional Communications System	Georgia Counties: Catoosa, Dade, Walker. Tennessee Counties: Anderson, Blount, Bradley, Hamilton, Knox, Loudon, McMinn, Meigs, Rhea, Roane	700 MHz/800 MHz
Oconee Area Radio System (OARS)	Greene County, Oconee County, Walton County	700 MHz/800 MHz

Source: (State of Georgia, 2012a)

Legacy VHF and UHF systems typically provide dispatch and tactical voice communication capabilities to cities, towns, and counties in Georgia for local police/sheriff, fire, and EMS users. Richmond County, in western Georgia where the city of Augusta is located, is typical of the situation in Georgia where VHF as well as UHF frequencies are used by a diverse set of public safety users including Richmond County Sheriff (Narcotics—VHF), fire (Water Rescue and Tactical Communications—VHF), and EMS (Dispatch/Medevac-VHF) (RadioReference.com, 2015d). In addition, the sheriff’s department as well as fire public safety users also have access to 800 MHz network frequencies (RadioReference.com, 2015d).

*Public Safety Answering Points (PSAPs)*

According to the Federal Communication Commission’s (FCC) Master PSAP registry, there are 208 PSAPs in Georgia serving 159 counties (FCC, 2016c).

## Commercial Telecommunications Infrastructure

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

### *Carriers, Coverage, and Subscribers*

Georgia’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 6.1.1-8 presents the number of providers of switched access<sup>10</sup> lines, Internet access,<sup>11</sup> and mobile wireless services including coverage.

**Table 6.1.1-8: Telecommunications Access Providers and Coverage in Georgia, as of December 31, 2013**

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access line <sup>a</sup>	210	97% of households <sup>b</sup>
Internet access <sup>c</sup>	97	52% of households
Mobile Wireless <sup>d</sup>	14	99% of population

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

<sup>a</sup> 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 as the total of ILEC and non-ILEC providers (FCC, 2014b).

<sup>b</sup> Household coverage data provided by the FCC in “Universal Service Monitoring Report” as a Voice Penetration percentage (percentage of household with a telephone in the unit) and is current as of 2013.

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

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

<sup>10</sup> “A service connection between an end user and the local telephone company’s switch; the basis of plain old telephone services (POTS)” (FCC, 2014b).

<sup>11</sup> Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

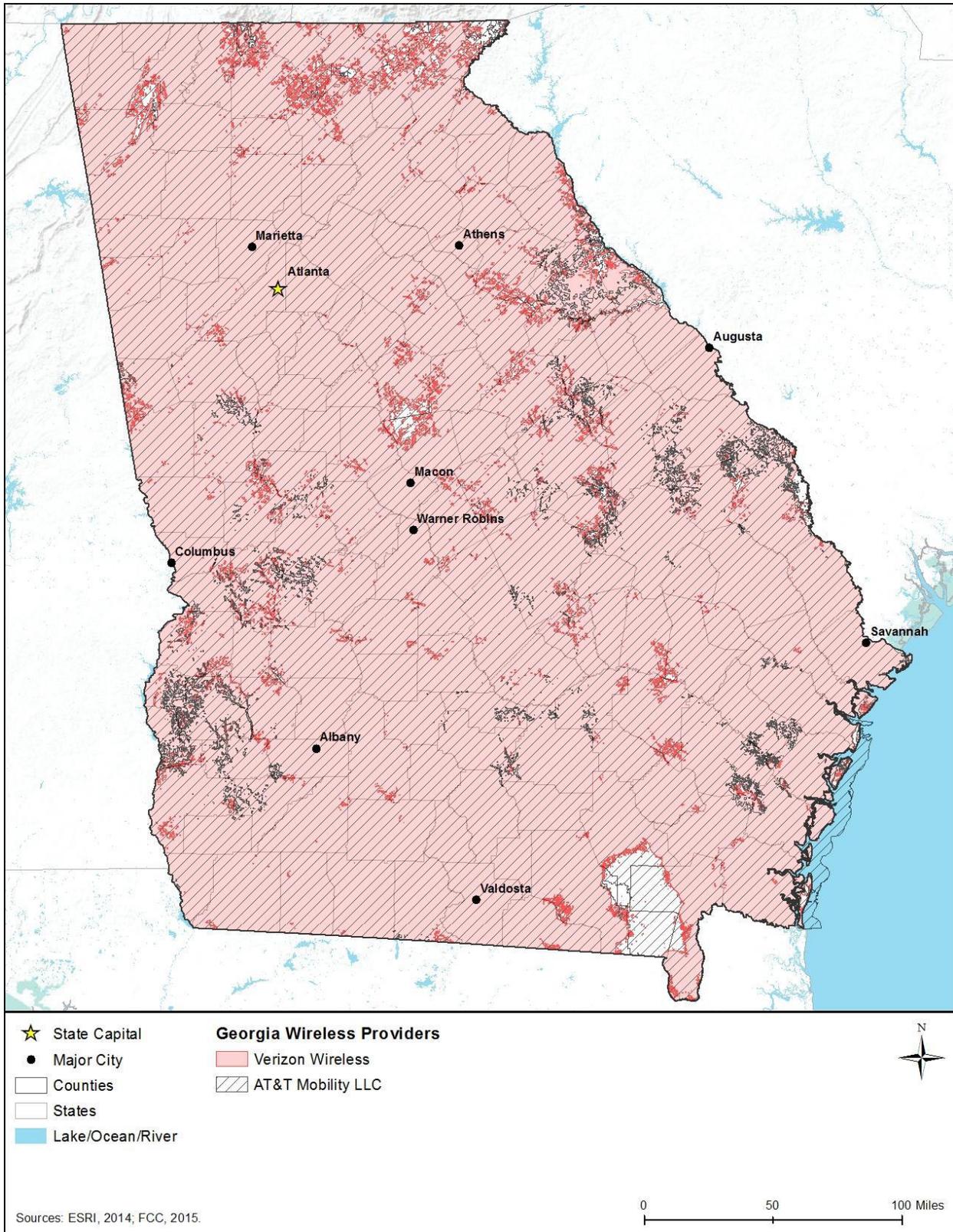
Table 6.1.1-9 shows the wireless providers in Georgia along with their geographic coverage. The following three maps: Figure 6.1.1-5, Figure 6.1.1-6, and Figure 6.1.1-7 show the combined coverage for the top two providers, AT&T and Verizon Wireless; Sprint, T-Mobile, and Public Service Data Wireless coverage; and the coverage of all other providers, respectively.

**Table 6.1.1-9: Wireless Telecommunications Coverage by Providers in Georgia**

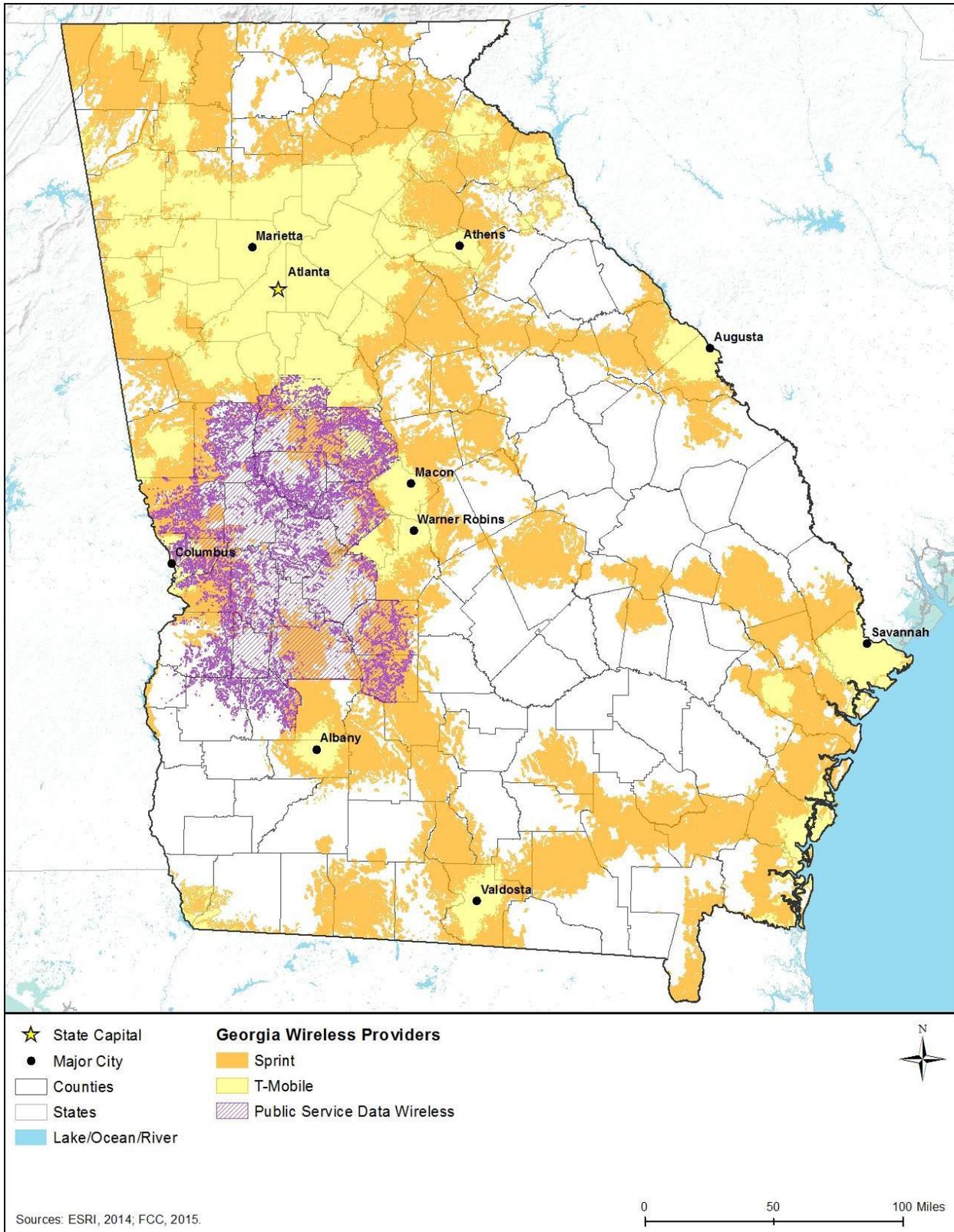
<b>Wireless Telecommunications Providers</b>	<b>Coverage</b>
AT&T Mobility LLC	98.47%
Verizon Wireless	95.44%
Sprint	44.25%
T-Mobile	20.20%
Public Service Data Wireless	7.94%
Other <sup>a</sup>	11.34%

Source: (NTIA, 2014)

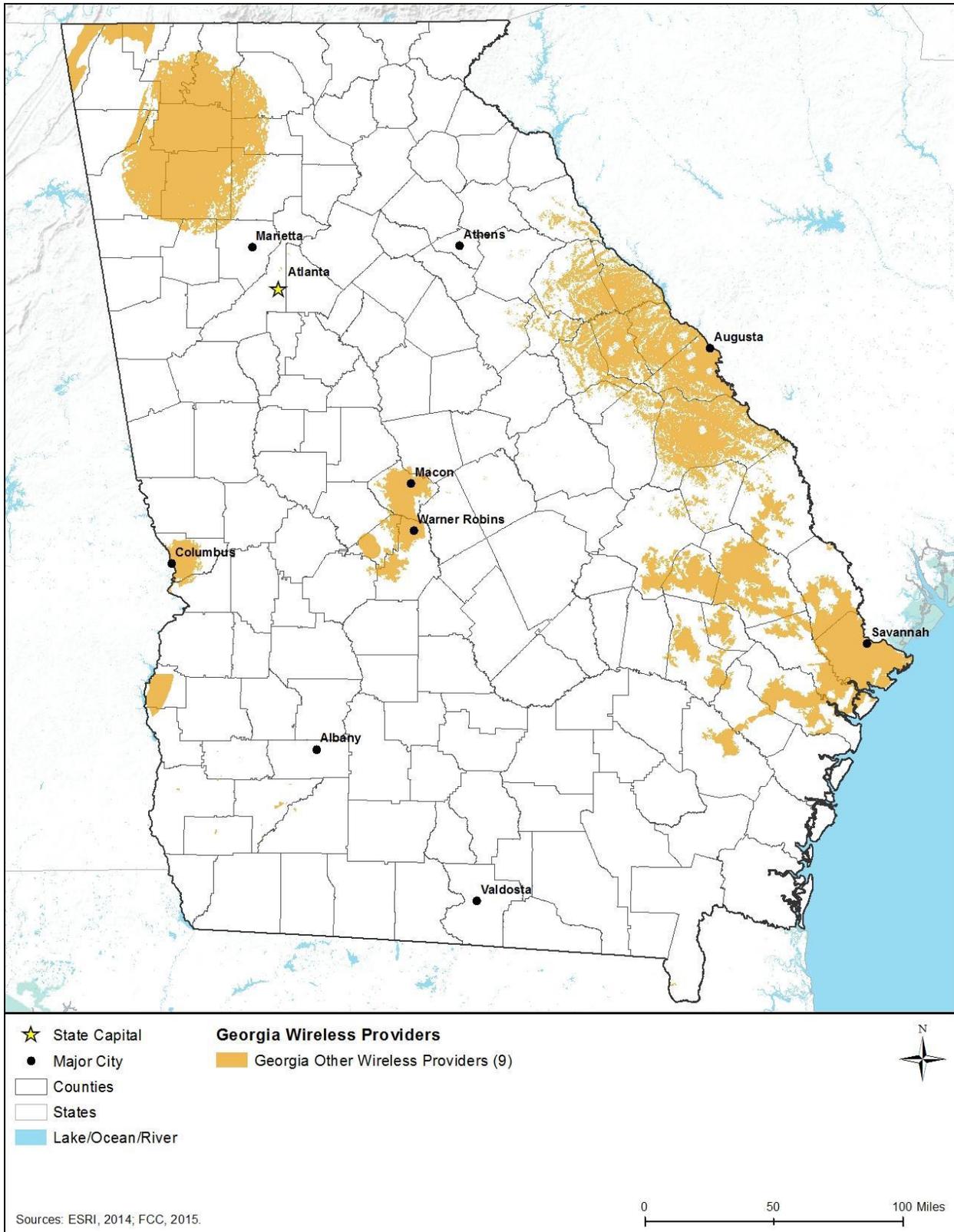
<sup>a</sup> Other: Provider with less than 5 percent coverage area include: Cricket Wireless; Advanced Technology Group; iWispr.Net; KitePilot Wireless Internet; AL-GA Wireless Broadband LLC; Fort Valley Utility Commission; SGRITA; Southeastern Services, Inc.; Nextlink Wireless, Inc.



**Figure 6.1.1-5: AT&T and Verizon Wireless Availability in Georgia**



**Figure 6.1.1-6: Sprint, T-Mobile, and Public Service Data Wireless Availability in Georgia**



**Figure 6.1.1-7: Other Providers Wireless Availability in Georgia**

### 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 6.1.1-8 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](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 6.1.1-8: Types of Towers**

Telecommunications tower infrastructure proliferates throughout Georgia, although tower infrastructure is concentrated in the higher and more densely populated areas of Georgia: Marietta, Atlanta, Athens, Augusta, Macon, Warner Robins, Columbus, Albany, Savannah, and Valdosta. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).<sup>12</sup> Table 6.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Georgia, by tower type, and Figure 6.1.1-9 presents the location of those 4,172 structures, as of June 2016.

<sup>12</sup> An antenna structure must be registered with the FCC if the antenna structure is taller than 200 feet above ground level or may interfere with the flight path of a nearby airport (FCC, 2016d).

**Table 6.1.1-10: Number of Commercial Towers in Georgia by Type**

<b>Constructed<sup>a</sup> Towers<sup>b</sup></b>		<b>Constructed Monopole Towers</b>	
100 ft. and over	676	100 ft. and over	0
75 ft. – 100 ft.	1,305	75 ft. – 100 ft.	3
50 ft. – 75 ft.	890	50 ft. – 75 ft.	111
25 ft. – 50 ft.	442	25 ft. – 50 ft.	108
25 ft. and below	44	25 ft. and below	11
<b>Subtotal</b>	<b>3,357</b>	<b>Subtotal</b>	<b>233</b>
<b>Constructed Guyed Towers</b>		<b>Buildings with Constructed Towers</b>	
100 ft. and over	115	100 ft. and over	4
75 ft. – 100 ft.	136	75 ft. – 100 ft.	0
50 ft. – 75 ft.	24	50 ft. – 75 ft.	5
25 ft. – 50 ft.	3	25 ft. – 50 ft.	3
25 ft. and below	0	25 ft. and below	0
<b>Subtotal</b>	<b>278</b>	<b>Subtotal</b>	<b>12</b>
<b>Constructed Lattice Towers</b>		<b>Multiple Constructed Structures<sup>c</sup></b>	
100 ft. and over	22	100 ft. and over	3
75 ft. – 100 ft.	167	75 ft. – 100 ft.	2
50 ft. – 75 ft.	63	50 ft. – 75 ft.	0
25 ft. – 50 ft.	19	25 ft. – 50 ft.	0
25 ft. and below	2	25 ft. and below	0
<b>Subtotal</b>	<b>273</b>	<b>Subtotal</b>	<b>5</b>
<b>Constructed Tanks<sup>d</sup></b>			
Tanks	14		
<b>Subtotal</b>	<b>14</b>		
<b>Total All Tower Structures</b>		<b>4,172</b>	

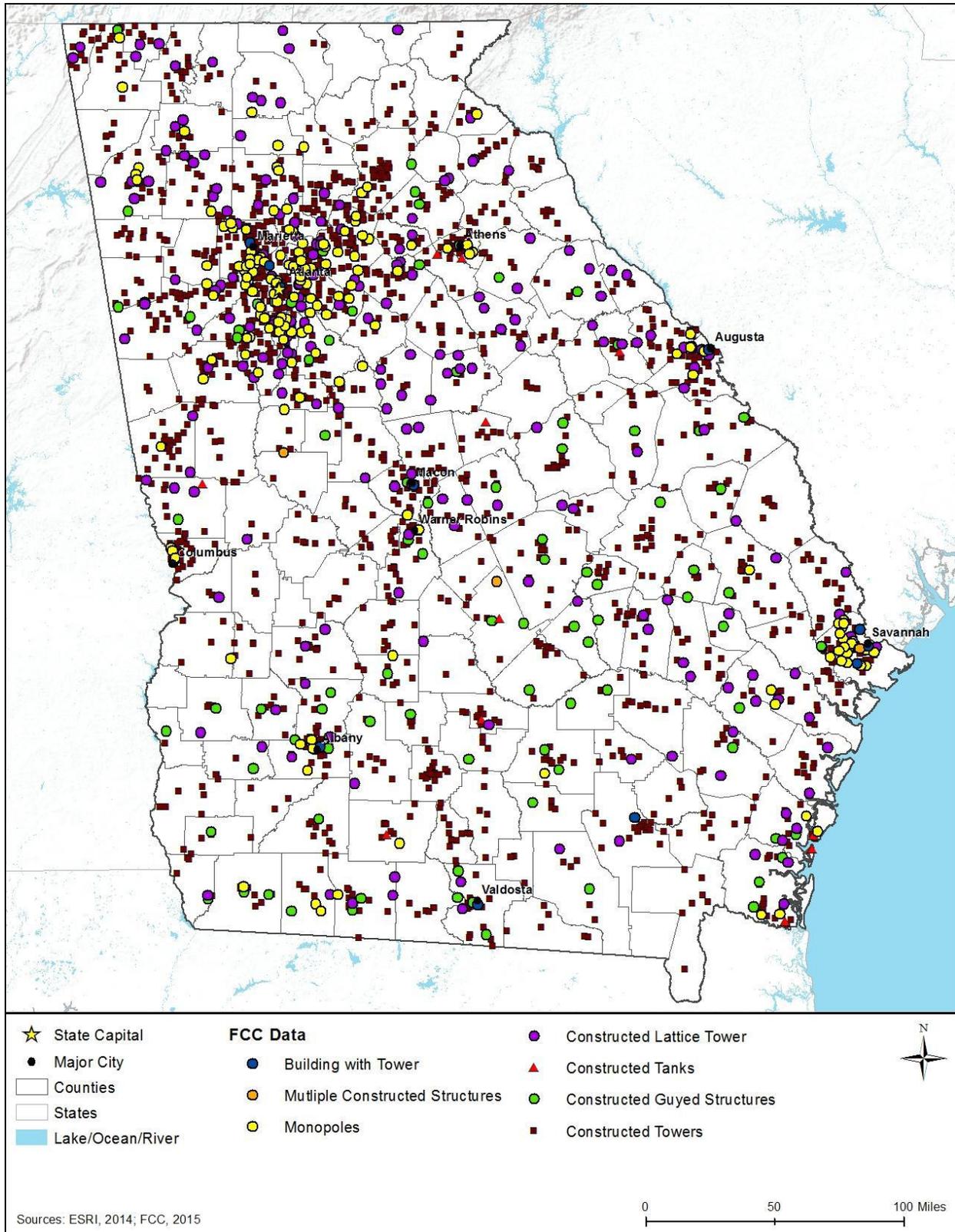
Source: (FCC, 2015)

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

<sup>b</sup> Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).

<sup>c</sup> Multiple constructed structures per antenna registration (FCC, 2016e).

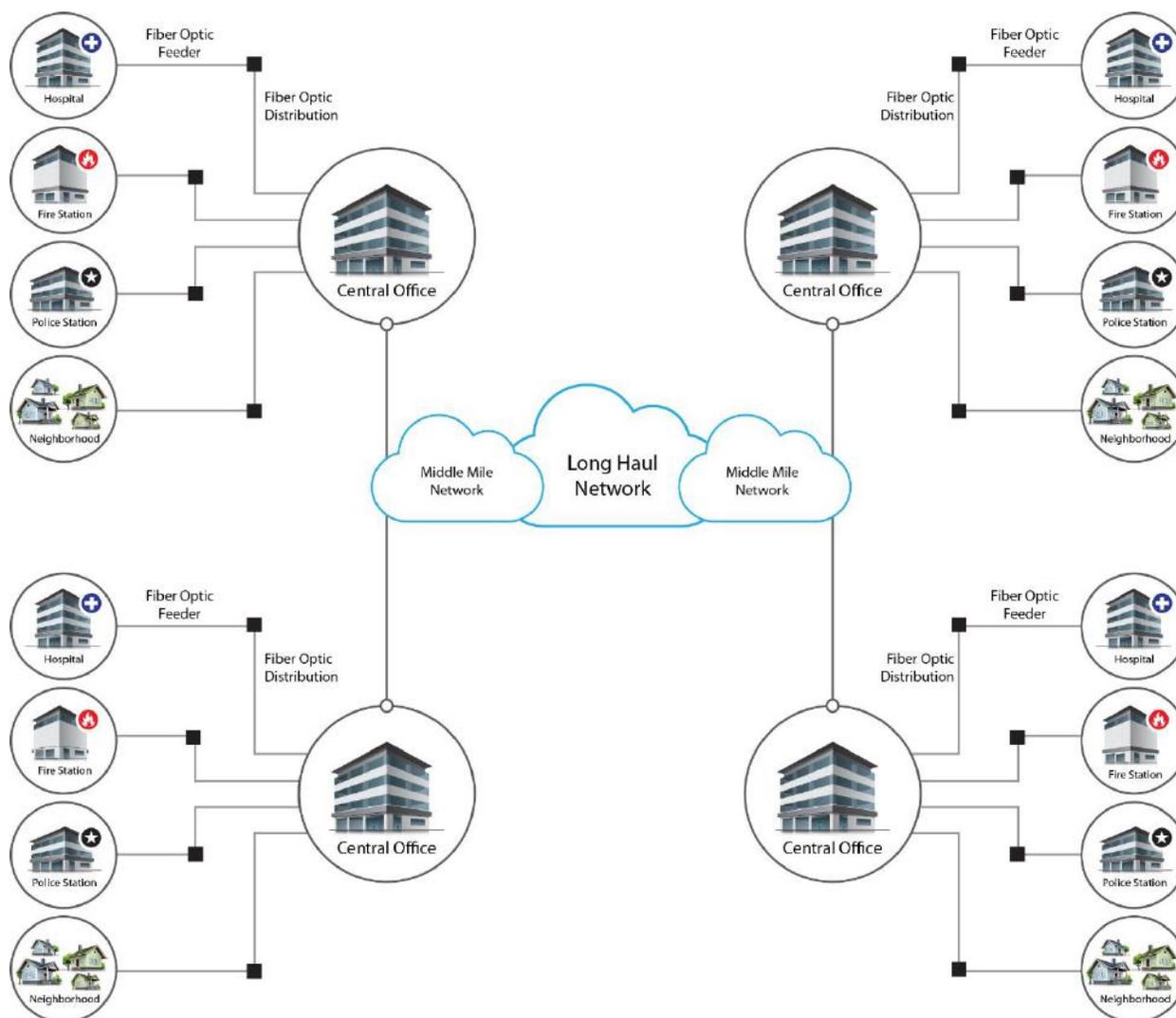
<sup>d</sup> Any type of tank – water, gas, etc. with a constructed antenna (FCC, 2016e).



**Figure 6.1.1-9: FCC Tower Structure Locations in Georgia**

*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 6.1.1-10. 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).



Source: (ITU-T, 2012)

Prepared by: Booz Allen Hamilton

**Figure 6.1.1-10: Typical Fiber Optic Network in Georgia**

*Last Mile Fiber Assets*

In Georgia, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Georgia, there are 67 fiber providers that offer service in the state, as listed in Table 6.1.1-11. Figure 6.1.1-11 shows coverage for AT&T Georgia and Windstream Corporation, Figure 6.1.1-12 shows coverage for Comcast, MegaPath Corporation, and Charter Communications Inc., and Figure 6.1.1-13 shows coverage for all other providers with less than 5 percent coverage area, respectively.<sup>13</sup>

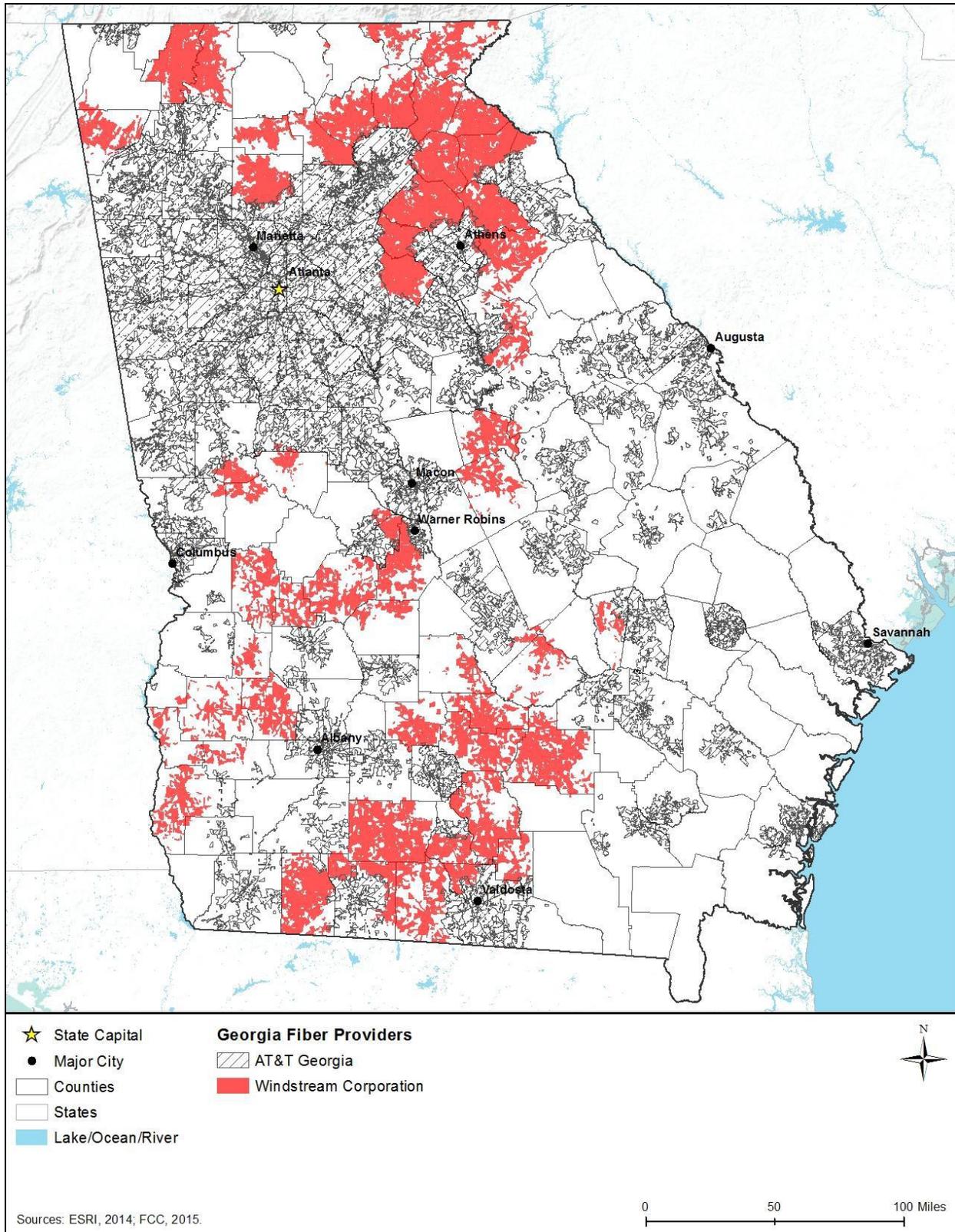
**Table 6.1.1-11: Fiber Provider Coverage**

Fiber Provider	Coverage
AT&T Georgia	21.24%
Windstream Corporation	10.88%
Comcast	10.04%
MegaPath Corporation	7.19%
Charter Communications Inc.	7.18%
Other <sup>a</sup>	24.91%

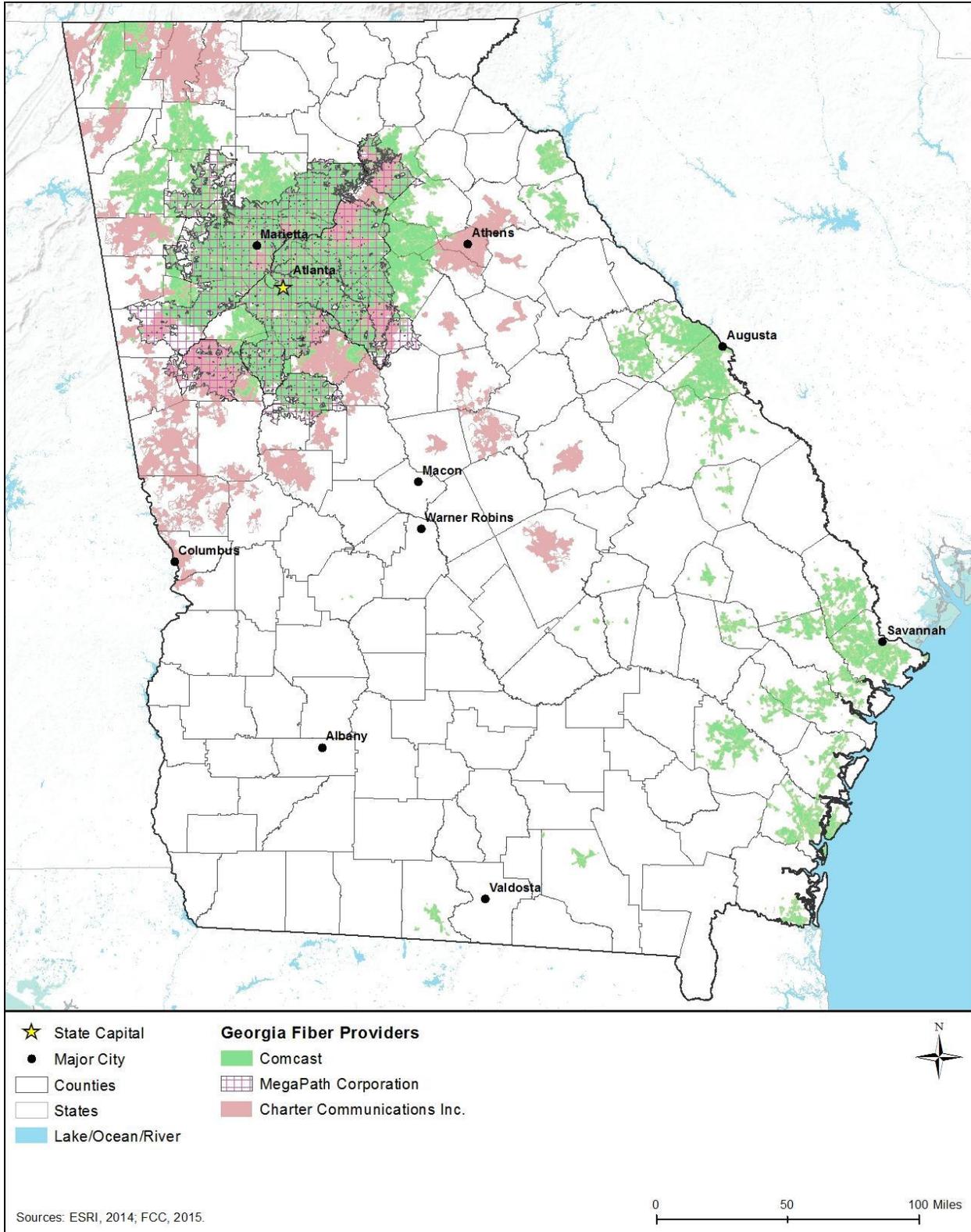
Source: (NTIA, 2014)

<sup>a</sup> Other: Provider with less than 5 percent coverage area. Providers include: Georgia Windstream, LLC; Mediacom; Pineland Telephone Company, Inc.; Plant Telephone Company; Flint Cable Television; Wilkes Telephone and Electric Co.; ETC Communications LLC; Bulloch County Rural Telephone Cooperative, Inc.; TDS Telecom; Planters Communications, LLC; NGN; Level 3 Communications, LLC; Citizens; ComSouth; Brantley Telephone, Inc.; Cox Communications; Frontier Communications; Vyve Broadband; Progressive Rural Telephone; Alma Telephone; Knology of Georgia, Inc.; CenturyLink Unite Private Networks, LLC; TruVista; Northland Communications; Dalton Utilities; TVN.net; NuLink Digital; Darien Telephone Company, Inc.; Hart Telephone Company; Pembroke Telephone Company, Inc.; ElbertonNET; City of Moultrie; City of Cairo; ATC Broadband LLC; Ringgold Telephone Company; City of Thomasville; FiberLight, LLC; Plant Tifnet; Chickamauga Telephone Corporation; XO Communications Services, Inc. (Affiliated Entity); Glenwood Telephone Company; Waverly Hall Telephone, LLC; Kings Bay Communications; FiberCom; Bulldog Cable Georgia, LLC; City of LaGrange; TW Telecom of Georgia L.P.; City of Dublin; City of Camilla; Hargray; Plantation Cablevision, Inc.; Fort Valley Utility Commission; CalNet; Kennedy Cablevision Inc.; City of Monroe; FairPoint Communications (GTCOM); Zayo Group, LLC; PeachNet; Bright House Networks, LLC; ATC; Cogent Communications, Inc.

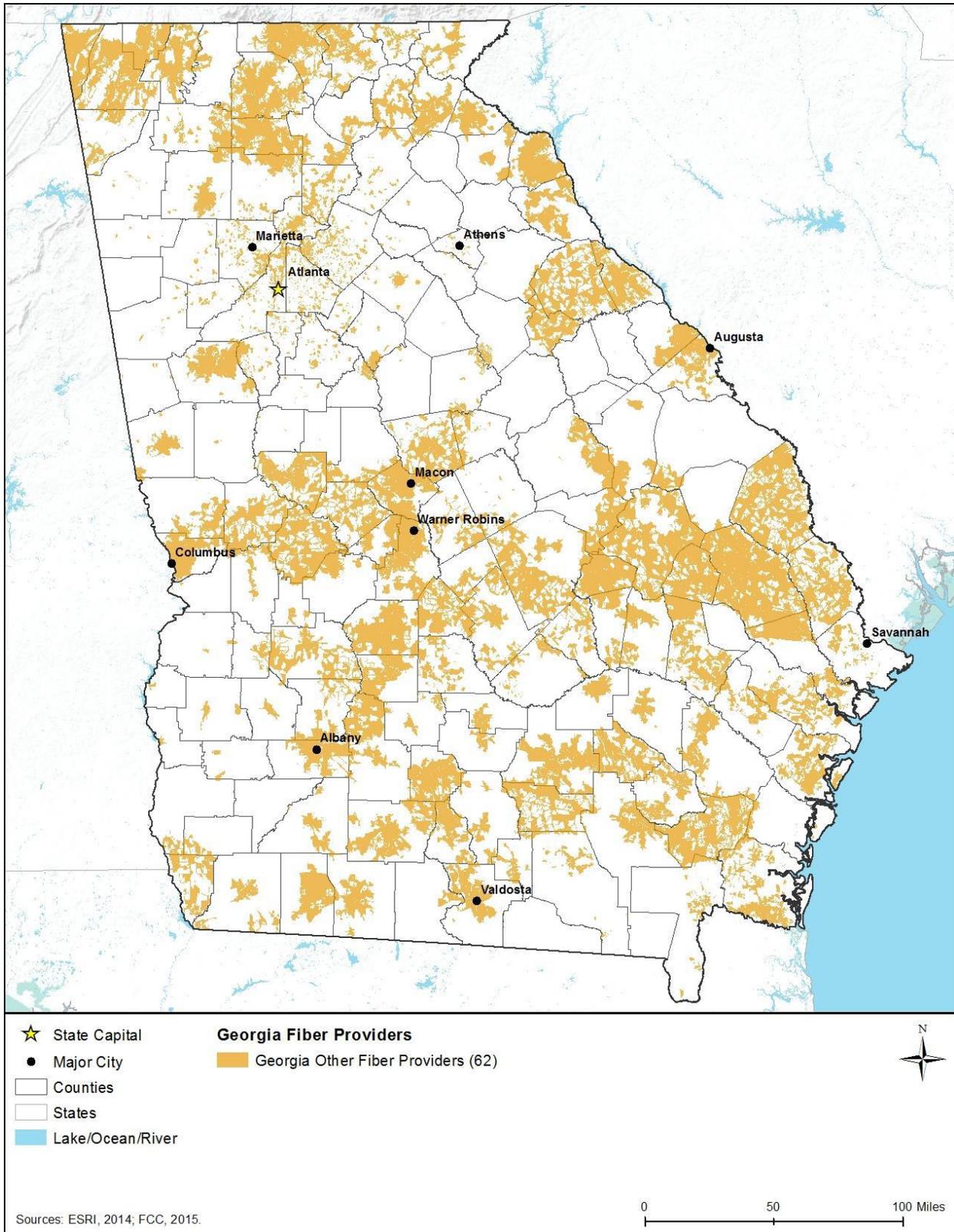
<sup>13</sup> The broadband map utilized data collected as part of the broadband American Recovery and Reinvestment Act initiative. The data was retrieved from the FCC National Broadband Map website ([www.broadbandmap.gov/data-download](http://www.broadbandmap.gov/data-download)). Each state’s broadband 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 “Georgia Other Fiber Providers”. All Wireless providers were mapped as well; those with areas under 5% were merged and mapped as “Georgia Other Wireless Providers”. Providers under 5% were denoted in their respective tables.



**Figure 6.1.1-11: Fiber Availability in Georgia for AT&T and Windstream Corporation**



**Figure 6.1.1-12: Comcast’s, MegaPath Corporation’s, and Charter Communication Inc.’s Fiber Availability in Georgia**



**Figure 6.1.1-13: Other Provider's Fiber Availability in Georgia**

### *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.

#### **6.1.1.6. 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 6.1.4, Water Resources, describes the potable water sources in the state.

#### **Electricity**

Many aspects of the electric utility business are overseen by the Georgia PSC. Overall, they regulate “the rates charged and the services provided by most intrastate....electric utilities operating in Georgia.” They also handle matters of financing and territory disagreements between utilities. For investor owned electric companies, they provide all of these services, while electric membership corporations have only their financing and territories overseen. Municipal power companies only require PSC involvement for issues concerning service territory. There is one investor owned electric utility in Georgia, 42 electric membership corporations, and 52 municipal electric companies (PSC, 2015a). The one investor owned company is Georgia Power Company (GPC), which serves approximately 2.4 million people (PSC, 2015b). Nearly all of the state’s electricity comes from three sources: Coal-fueled generation plants, natural gas fueled plants and nuclear power plants. Together, these account for more than 94 percent of electricity generated in the state (EIA, 2017a). Alone, coal accounts for 37,890 thousand megawatthours<sup>14</sup> out of the total 133,318 thousand megawatthours produced (EIA, 2017a). To contrast, natural gas accounted for 52,979 thousand megawatthours and nuclear power for 34,481 thousand megawatthours (EIA, 2017a). Other sources, such as petroleum liquids, coke, conventional hydroelectric power, and solar power produce some power for the state as well. The state’s transportation sector is its largest consumer of electricity, using 27.6 percent of the total in 2014, with the industrial sector using 27.0 percent, the residential using 26.1 percent, and the commercial sector just 19.3 percent. (EIA, 2014a).

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<sup>14</sup> One megawatthour is defined as “one thousand kilowatthours or one million watthours.” 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, 2016).

## **Water**

The quality of Georgia's drinking water is subject to regulations set forth in the Safe Drinking Water Act (SDWA). The SDWA sets limits on the amount of any given contaminant that may be present in drinking water produced by a public water system. Public water systems (PWS) are defined as "system[s] that provides water via 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" (GAEPD, 2015a). PWSs are divided into three categories: "community (such as towns), non-transient non-community (such as schools or factories), or transient non-community systems (such as rest stops or parks)" (GAEPD, 2015a).

The requirements set forth by the SDWA are enforced by Georgia's Department of Natural Resources (GADNR) Environmental Protection Division (GAEPD). GAEPD also requires that all PWS publicize yearly reports for their customers that includes information on water sources, as well as information on any contaminants in the water. In 2014, there were about 960 violations found in Georgia PWS, though most were minor and were resolved immediately. Of these, 844 came from community water systems, 31 from non-transient non-community systems, and 85 from transient non-community systems (GAEPD, 2015a).

## **Wastewater**

Management of Georgia's wastewater is handled by several separate programs and agencies. The use of onsite treatment or disposal facilities like septic tanks is overseen by GADPH. Programs run by the GADPH regulate the installation of new onsite systems and inspect repairs of existing systems to ensure they are completed properly. They also handle the education and certification of personnel involved with the installation and maintenance of onsite systems (GADPH, 2015a). Discharge of wastewater in Georgia requires a National Pollutant Discharge Elimination System (NPDES) permit, as mandated by the U.S. Environmental Protection Agency (USEPA). While many states choose to implement their own programs to permit wastewater facilities, some states opt not to. In these cases, the USEPA has the responsibility to address issues of permitting themselves (USEPA, 2015a). Georgia is one such case, and NPDES permits are issued by the USEPA. Among others, the USEPA offers general permits, municipal discharge permits, animal feeding operation permits, and industrial stormwater permits (GAEPD, 2015b). Operators of wastewater treatment facilities must be certified and licensed by the state. This process is the responsibility of the Office of the Secretary of State, and is facilitated through the Georgia State Board of Examiners for the Certification of Water and Wastewater Treatment Plant Operators and Laboratory Analysts (SOS, 2015).

## **Solid Waste Management**

Many aspects of Georgia's solid waste management are directed by GAEPD's Solid Waste Management Program, which is organized into smaller units designed to tackle specific issues. Among these are the Environmental Monitoring Compliance Unit and the Industrial and Municipal Solid Waste Unit. The Environmental Monitoring Compliance Unit handles groundwater and surface water monitoring permits as well as ensuring regulatory compliance for all solid waste facilities. Among its other responsibilities, the Industrial and Municipal Solid

Waste Unit handles the “permitting, including review of site suitability reports, financial assurance, construction, closure of all publicly and privately owned solid waste handling facilities” (GAEPD, 2015c).

As of January of 2014, there were also 221 closed landfills in the state. There are a total of 141 open permitted landfills, and constitute a collection of municipal, industrial, construction and demolition, and unlined sanitary landfills. Regarding other solid waste management facilities, there are also five composting operations, 13 material recovery facilities, and 217 transfer facilities in Georgia. A report on 2014 landfill statistics indicates that there are 736,698,649 cubic yards of useable space in Georgia’s landfills (GAEPD, 2015d). By 2017, Georgia expects to see municipal solid waste reduction per capita rise to a rate of 23 percent (DCA, 2015).

## 6.1.2. Soils

### 6.1.2.1. 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, 2015a)
- (ii) “The unconsolidated mineral or organic matter on the surface of the Earth that has been subjected to and shows effects of genetic and environmental factors of: climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting on parent material over a period of time. A product-soil differs from the material from which it is derived in many physical, chemical, biological, and morphological properties and characteristics.” (NRCS, 2015a)

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

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

### 6.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Appendix C,

Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 6.1.2-1 below.

**Table 6.1.2-1: Relevant Georgia Soils Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Georgia Erosion and Sediment Control Act of 1975 (Official Code of Georgia Annotated §12-7-1 et seq.)	Georgia Soil and Water Conservation Commission	This act requires all counties, along with 556 incorporated municipalities, to adopt ordinances that address land-disturbing activities, including permitting issuance procedures. These ordinances meet or exceed the requirements of the NPDES general permit.

Source: (GASWCC, 2015)

**6.1.2.3. Environmental Setting**

Georgia is composed of three Land Resource Region (LRR),<sup>15</sup> as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Atlantic and Gulf Coast Lowland Forest and Crop Region;
- East and Central Farming and Forest Region; and
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region.

Within and among Georgia’s three LRRs are eight Major Land Resource Areas (MLRA),<sup>16</sup> which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Georgia’s MLRAs are presented in Figure 6.1.2-1 and Table 6.1.2-2.

Soil characteristics are an important consideration for FirstNet inasmuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota<sup>17</sup> such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils<sup>18</sup> 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<sup>19</sup> (discussed further in the subsections below).

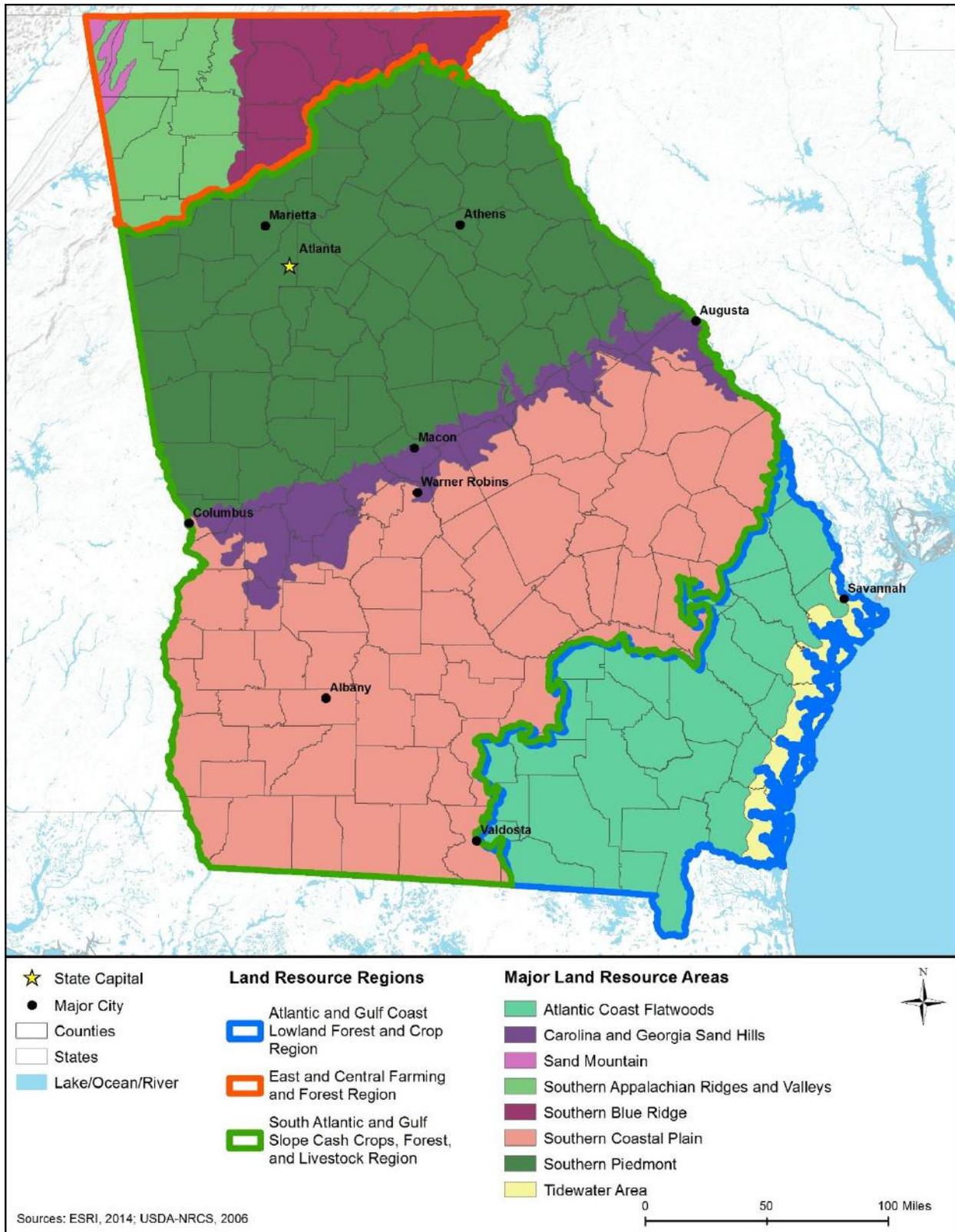
<sup>15</sup> Land Resource Region: “A geographical area made up of an aggregation of [MLRA] with similar characteristics” (NRCS, 2006).

<sup>16</sup> 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).

<sup>17</sup> All living organisms of an area.

<sup>18</sup> Expansive soils are characterized by “the presence of swelling clay minerals” that absorb water molecules when wet and expand in size or shrink when dry leaving “voids in the soil” (Rogers, Olshansky, & Rogers, 2004).

<sup>19</sup> Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFS, 2009b).



**Figure 6.1.2-1: Locations of Major Land Resource Areas in Georgia**

**Table 6.1.2-2: Characteristics of Major Land Resource Areas in Georgia**

MLRA Name	Region of State	Soil Characteristics
Atlantic Coast Flatwoods	Southeastern Georgia	Spodosols <sup>a</sup> and Ultisols <sup>b</sup> are the dominant soil orders. These clayey or loamy <sup>c</sup> soils typically range from well drained to poorly drained, and are very deep.
Carolina and Georgia Sand Hills	Central Georgia	Entisols <sup>d</sup> and Ultisols are the dominant soil orders. These loamy or sandy soils range from well drained to excessively drained, and are very deep.
Sand Mountain	Northwestern Georgia	Inceptisols <sup>e</sup> and Ultisols are the dominant soil orders. These well drained and loamy soils range from shallow to very deep.
Southern Appalachian Ridges and Valleys	Northwestern Georgia	These soils are typically Ultisols and Inceptisols (less so). They are clayey and well drained, and range from shallow to very deep.
Southern Blue Ridge	Northeastern Georgia	Inceptisols and Ultisols are the dominant soil orders. These clayey or loamy soils range from shallow to very deep.
Southern Coastal Plain	Southern Georgia	Entisols, Inceptisols, and Ultisols are the dominant soil orders. These loamy soils are typically very deep. They range from poorly drained to somewhat excessively drained.
Southern Piedmont	Northern Georgia	Alfisols, <sup>f</sup> Inceptisols, and Ultisols are the dominant soil orders. These loamy or clayey soils are typically well drained, and range from shallow to very deep.
Tidewater Area	Southeastern Georgia	Alfisols and Entisols are the dominant soil orders, with Histosols <sup>g</sup> less so. These soils are very deep, and clayey or loamy, with drainage that is restricted.

Source: (NRCS, 2006)

<sup>a</sup> Spodosols: “Soils formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in subsoil. They commonly occur in areas of coarse-textured deposits under forests of humid regions, tend to be acid and infertile, and make up nearly 4 percent of the world’s ice-free land surface” (NRCS, 2015b).

<sup>b</sup> 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, 2015b).

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

<sup>d</sup> 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, 2015b).

<sup>e</sup> 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, 2015b).

<sup>f</sup> 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, 2015b).

<sup>g</sup> Histosols: “Soils that have a high content of organic matter and no permafrost. Also known as bogs, moors, peats, or mucks, these soils are saturated year round and form in decomposed plant remains. If exposed to air and drained, the microbes will decompose and the soils can subside dramatically. They make up nearly 1 percent of the world’s ice-free land surface” (NRCS, 2015b).

#### **6.1.2.4. Soil Suborders**

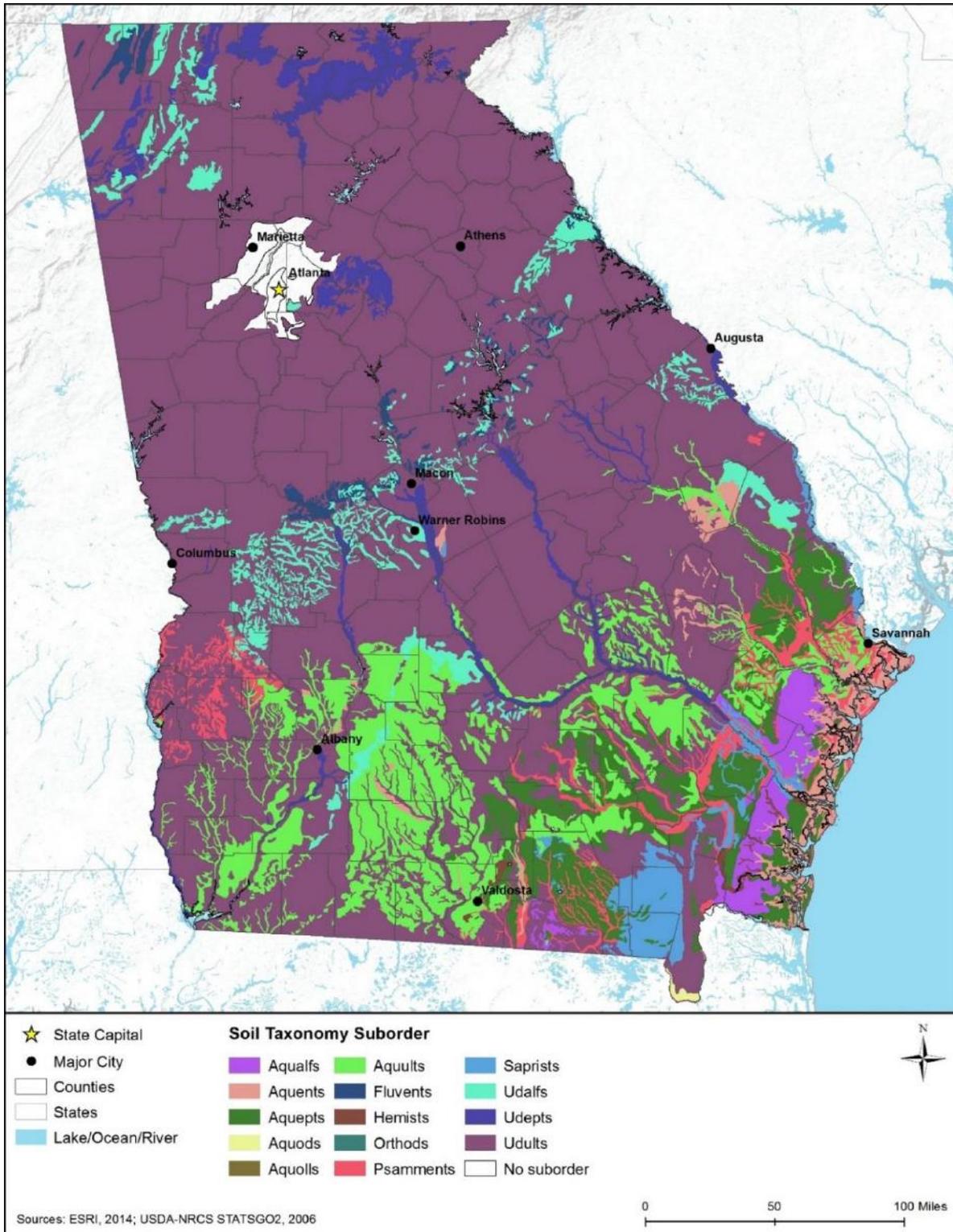
Soil suborders are part of the soil taxonomy (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy;<sup>20</sup> there are twelve soil orders in the world and they are characterized by both observed and inferred<sup>21</sup> properties, 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, 2015c). FirstNet used the STATSGO2 database to obtain soils information at the programmatic level to ensure consistency across all the states and territories. This regional information provides a sufficient level of detail for a programmatic analysis. The best available soils data and information, including the use of the more detailed SSURGO database, will be used, as appropriate, during subsequent site-specific assessments. The STATSGO2<sup>22</sup> soil database identifies 14 different soil suborders in Georgia (NRCS, 2015d). Figure 6.1.2-2 depicts the distribution of the soil suborders, and Table 6.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

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<sup>20</sup> Taxonomy: A formal representation of relationships between items in a hierarchical structure (USEPA, 2013a).

<sup>21</sup> “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, 2015c).

<sup>22</sup> STATSGO2 is the Digital General Soil Map of the United States developed by the National Cooperative Soil Survey and supersedes the State Soil Geographic (STATSGO) dataset; the U.S. General Soil Map is comprised of general soil association units and is maintained and distributed as a spatial and tabular dataset.



**Figure 6.1.2-2: Georgia Soil Taxonomy<sup>23</sup> Suborders**

<sup>23</sup> Soil taxonomies are defined in Table 6.1.2-3.

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**Table 6.1.2-3: Major Characteristics of Soil Suborders Found in Georgia, as depicted in Figure 6.1.2-2**

Soil Order	Soil Suborder <sup>a</sup>	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil <sup>b</sup>	Hydrologic Group	Runoff Potential	Permeability <sup>c</sup>	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.	Clay loam <sup>d</sup> , Fine sandy loam, Sandy clay	0-2	Very poorly drained to poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Aquepts	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquepts support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Loamy sand, Sandy loam, Silty clay loam	0-2	Very poorly drained to poorly drained	Yes	A, D	Low, High	High, Very Low	Low 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.	Loam, Sand	0-2	Very poorly drained	Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Spodosols	Aquods	Aquods are characterized by a shallow fluctuating water table, with water-loving vegetation, ranging from moss, shrubs, and trees in cold areas to mixed forests and palms in the warmest areas. Although some Aquods have been cleared and are used as cropland or pasture, most are used as forest or wildlife habitat, as they are naturally infertile (but they can be highly responsive to good management).	Sand	0-2	Very 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 loam	0-2	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Ultisols	Aquults	Aquults are found in wet areas where groundwater is very close to the surface during part of each year, usually in winter and spring. Their slopes are gentle, with many soils formerly and currently supporting forest vegetation.	Clay, Clay loam, Fine sandy loam, Loam, Loamy sand, Sandy clay, Sandy clay loam	0-2	Very poorly drained to 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
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.	Fine sandy loam, Silt loam	0-2	Somewhat poorly drained to moderately well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Histosols	Hemists	Hemists are usually found in broad, flat areas, such as coastal plains and outwash plains as well as closed depressions. They are typically under natural vegetation and uses for rangeland, woodlands, and/or wildlife habitat, although some large areas have been cleared and drained, and utilized for cropland.	Mucky peat	0-1	Very poorly drained	Yes	A, D	Low, High	High, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions
Spodosols	Orthods	Orthods have a moderate accumulation of organic carbon, and are relatively freely drained. Most of these soils are either used as forest or have been cleared and are used as cropland or pasture. Although they are naturally infertile, they can be highly responsive to good management.	Sand	0-2	Somewhat poorly drained	No	C	Medium	Low	Medium	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Fine sand, Sand	0-10	Somewhat poorly drained to excessively drained	No	A, C	Low, Medium	High, Low	Low to Medium, depending on slope	Low

Soil Order	Soil Suborder <sup>a</sup>	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil <sup>b</sup>	Hydrologic Group	Runoff Potential	Permeability <sup>c</sup>	Erosion Potential	Compaction and Rutting Potential
Histosols	Saprists	Saprists have organic materials are well decomposed, and many support natural vegetation and are used as woodland, rangeland, or wildlife habitat. Some Saprists, particularly those with a mesic or warmer temperature regime, have been cleared, drained, and used as cropland.	Muck, Sandy loam	0-2	Very poorly drained	Yes	D	High	Very Low	High	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, Sandy loam, Silty clay	1-12	Somewhat poorly drained to moderately well drained	No	C, D	Medium, High	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.	Channery <sup>e</sup> silt loam, Extremely channery loam, Loam, Sand, Sandy loam, Silt loam, Weathered bedrock	0-65	Somewhat poorly drained to somewhat 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).	Channery loam, Clay, Clay loam, Extremely gravelly fine sandy loam, Fine sandy loam, Gravelly clay loam, Gravelly loam, Gravelly silt loam, Gravelly silty clay, Gravelly silty clay loam, Loam, Loamy sand, Sand, Sandy clay, Sandy clay loam, Sandy loam, Unweathered bedrock, Variable, Very fine sandy loam, Weathered bedrock	0-60	Somewhat poorly drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low

Source: (NRCS, 2015d) (NRCS, 1999)

<sup>a</sup> 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.

<sup>b</sup> 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, 2015e). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.

<sup>c</sup> Based on Runoff Potential, described in Section 6.1.2.5.

<sup>d</sup> Loam: Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles (University of Delaware, 2016).

<sup>e</sup> Channery: An accumulation of thin, flat, coarse fragments of sandstone, limestone or schist up to 6 inches (University of Delaware, 2016).

### **6.1.2.5. Runoff Potential**

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.<sup>24</sup> Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 6.1.2-3 provides a summary of the runoff potential for each soil suborder in Georgia.

**Group A Sand, loamy sand or sandy loam soils.** This group of soils has “low runoff potential and high infiltration rates<sup>25</sup> 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). Aquepts, Hemists, Psamments, and Udults fall into this category in Georgia.

**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. Aquepts, Aquults, Fluvents, Udepts, and Udults fall into this category in Georgia.

**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. Fluvents, Orthods, Psamments, Udalfs, Udepts, and Udults fall into this category in Georgia.

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

### **6.1.2.6. 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 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 6.1.2-3 provides a summary of the erosion potential

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<sup>24</sup> 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.

<sup>25</sup> 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).

for each soil suborder in Georgia. Soils with medium to high erosion potential in Georgia include those in the Aqualfs, Aquepts, Aquolls, Aquults, Fluvents, Hemists, Orthods, Psamments, Sapristis, Udalfs, Udepts, and Udults suborders, which are found throughout the state (Figure 6.1.2-2).

#### **6.1.2.7. *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, 2009a). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than ten tons can cause soil compaction of greater than 12 inches depth (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 6.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Georgia. Soils with the highest potential for compaction and rutting in Georgia include those in the Aqualfs, Aquepts, Aquolls, Aquults, Hemists, and Sapristis suborders, which are found primarily in the southern and southeastern parts of the state (Figure 6.1.2-2).

### **6.1.3. Geology**

#### **6.1.3.1. *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 groundwater availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 6.1.4), Human Health and Safety (Section 6.1.15), and Climate Change (Section 6.1.14).

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

- Section 6.1.3.3, Major Physiographic Regions<sup>26</sup> and Provinces;<sup>27</sup>
- Section 6.1.3.4, Surface Geology;
- Section 6.1.3.5, Bedrock Geology;<sup>28</sup>
- Section 6.1.3.6, Paleontological Resources;<sup>29</sup>
- Section 6.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 6.1.3.8, Geologic Hazards.<sup>30</sup>

**6.1.3.2. 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 6.1.3-1.

**Table 6.1.3-1: Relevant Georgia Geology Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Georgia State Amendments to the International Building Code (2012 Edition)	Georgia Department of Community Affairs	Guidelines for Seismic Design.

Source: (GADCA, 2014)

**6.1.3.3. Major 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, in a large proportion of cases, 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 subdivided into physiographic provinces based on differences observed on a more local scale. (Fenneman, 1916)

Georgia is within two physiographic regions: Atlantic Plain (Coastal Plain Province) and Appalachian Highlands (Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateaus Provinces) (USG, 2004) (Figure 6.1.3-1). The general characteristics of these regions and their respective provinces are summarized in the following subsections.

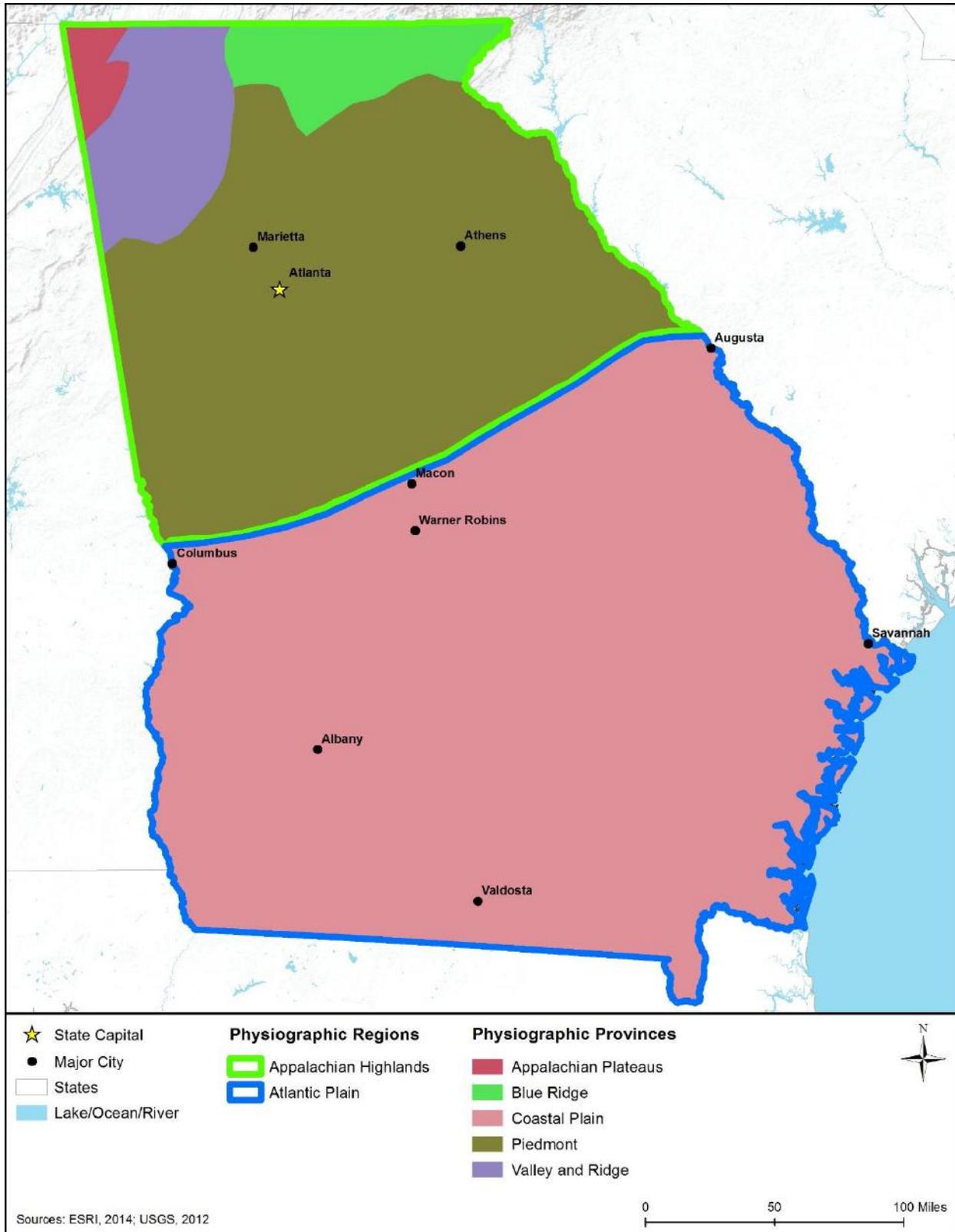
<sup>26</sup> Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).

<sup>27</sup> Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

<sup>28</sup> Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015b).

<sup>29</sup> Paleontology: “Study of life in past geologic time based on fossil plants and animals” (USGS, 2015c).

<sup>30</sup> 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 6.1.3-1: Physiographic Regions and Provinces of Georgia**

## **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<sup>31</sup> 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.<sup>32</sup> (NPS, 2015a)

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

Coastal Plain Province – Within Georgia, the Coastal Plain Province includes roughly 35,000 miles of the state south of the Fall Line<sup>33</sup> boundary with the Piedmont Province (discussed below). “In Georgia this line extends in a northeast-southwest course from Augusta through Milledgeville and Macon to Columbus” (GSG, 1911). While the northern portion of the province, in north-central Georgia, contains sporadic small hills, the majority of the province is flat-lying and generally decreases in elevation moving toward the south at about three to four feet per mile until reaching the coastline. The highest elevations in the province lie between Macon and Columbus at about 650 to 700 feet above sea level (ASL) (GSG, 1911).

## **Appalachian Highlands Region**

The Appalachian Highlands Region extends from Canada to Alabama. This region is composed of layers of folded sedimentary rock, created when the North American plates collided with the Eurasian and African plates more than MYA. Once similar in height to the present-day Rocky Mountains,<sup>34</sup> the Appalachian Highlands have eroded considerably. The current Appalachian Highlands Region is characterized by prime and unique farmlands and is rich in mineral resources. (QAB, 1968)

As reported above, the Appalachian Highlands Region within Georgia is composed of four physiographic provinces: the Piedmont, Blue Ridge, Valley and Ridge, and Appalachian Plateaus Provinces (USGS, 2003a).

Piedmont Province – Georgia’s Piedmont Province is a hilly terrain between the Coastal Plain and the mountainous areas in the northern portion of the state. Elevations throughout the province range from 300 to 1,200 feet ASL and generally decrease toward the south and east (GSG, 1911).

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<sup>31</sup> 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, 2014a).

<sup>32</sup> For consistency, this PEIS uses the University of California Berkeley Geologic Time Scale for all of the FirstNet PEIS state documents. Time scales differ among universities and researchers; FirstNet utilized a consistent time scale throughout, which may differ slightly from other sources. (University of California Museum of Paleontology, 2011)

<sup>33</sup> Fall Line: “Imaginary line marking the boundary between the ancient, resistant crystalline rocks of the Piedmont province of the Appalachian Mountains, and the younger, softer sediments of the Atlantic Coastal Plain province in the Eastern United States. Along rivers, this line commonly is reflected by waterfalls” (USGS, 2013a).

<sup>34</sup> The Rocky Mountains exceed 14,000 feet above sea level (NPS, 2004).

Blue Ridge Province – Georgia’s Blue Ridge Province is a rugged terrain in the northeastern portion of the state. Most peaks throughout the province are about 4,000 feet ASL, though the highest elevation reaches more than 5,000 feet ASL (GSG, 1911).

Valley and Ridge Province – Georgia’s Valley and Ridge Province includes much of the northwestern portion of the state, with the exception of Dade, Walker, and Chattooga Counties. The valleys and ridges trend in a north-south direction. The valley elevations range from 600 to 900 feet ASL and the ridges range from 1,000 to 1,800 feet (GSG, 1911).

Appalachian Plateaus Province – Georgia’s Appalachian Plateaus Province includes the northwestern corner of the state, including portions of Dade, Walker, and Chattooga Counties. “The [Appalachian] Plateau is made up of flat-topped mountains or tablelands of Carboniferous strata... and has an elevation of 1,500 to 2,300 feet above sea level.” Topographic relief between plateau tops and surrounding valleys is precipitous, and generally between 700 and 1,400 feet (GSG, 1911).

#### **6.1.3.4. Surface Geology**

Surficial geology is characterized by materials such as till,<sup>35</sup> sand and gravel, or clays that overlie bedrock. The surface terrain, which can include bedrock outcrops, provides information on the rock compositions and structural characteristics of the underlying geology. Because surface materials are exposed, they are subject to physical and chemical changes due to weathering from precipitation (rain and snow), wind and other weather events, and human-caused interference. Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,<sup>36</sup> subsidence,<sup>37</sup> and erosion (Thompson, W., 2015).

Most of the surficial materials in Georgia are Pleistocene (2.6 MYA to 11,700 years ago) deposits within the Coastal Plain Province. These deposits contain sand and gravel that thickens from a very thin layer at the Fall Line to more than 60 feet deep along some areas of the coastline (including Charlton and Camden Counties in southeastern Georgia). Deposits dip<sup>38</sup> to the southeast at about two feet per mile. “These sediments have the physiographic form of marine terraces, having flat-topped areas with rather steep seaward slopes” (Herrick, 1965). It is likely that sediment deposits originated in the Piedmont Province within northeastern Georgia and southwestern South Carolina. Alluvial deposits along the floodplains of major rivers overtop Pleistocene deposits in isolated areas of the Coastal Plain (Herrick, 1965). Figure 6.1.3-2 depicts the main surficial composition of Georgia.

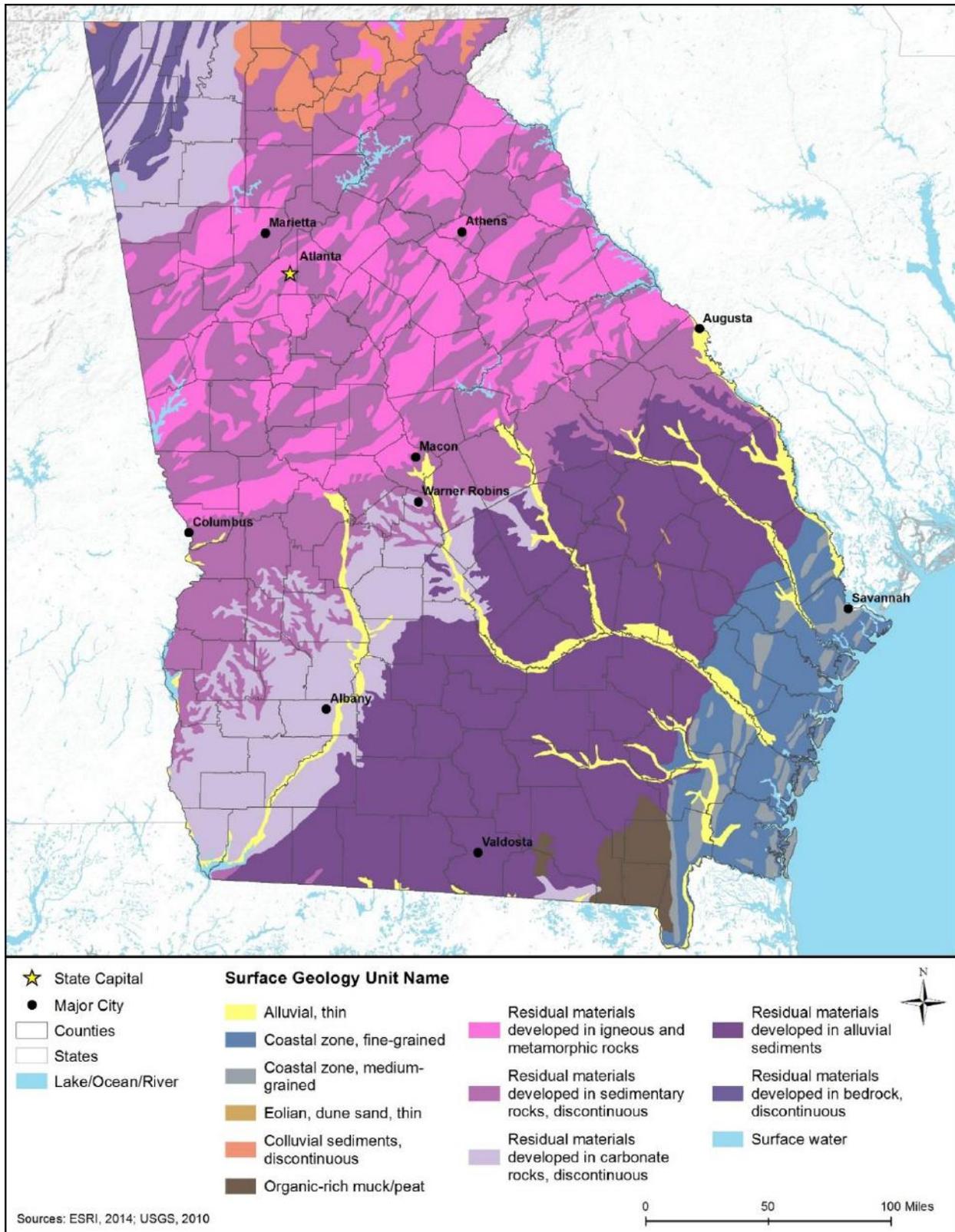
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<sup>35</sup> Till: “An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water” (USGS, 2013b).

<sup>36</sup> 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)

<sup>37</sup> Subsidence: “Gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials” (USGS, 2000).

<sup>38</sup> 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).



**Figure 6.1.3-2: Generalized Surface Geology for Georgia**

### 6.1.3.5. *Bedrock Geology*

Bedrock geology analysis, and the study of “distribution, position, shape, and internal structure of rocks” (USGS, 2015d) reveals important information about a region’s surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),<sup>39</sup> rock composition, and regional tectonism.<sup>40</sup> 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 (NHDES, 2014).

Georgia’s bedrock geology follows the same delineations as the physiographic regions and provinces discussed in Section 6.1.3.3. Figure 6.1.3-3 displays the general bedrock geology for Georgia.

- Georgia’s Coastal Plain Province is composed of coarse-grained sedimentary rocks that date primarily from the Cretaceous (146 to 66 MYA) and Tertiary (66 to 2.6 MYA) Periods (USGS, 2015f).
- The Piedmont Province is underlain by deformed igneous<sup>41</sup> and metamorphic<sup>42</sup> rocks; “the main rock types are gneiss<sup>43</sup> and schist<sup>44</sup> of various compositions; however, extremely fine-grained rocks, such as phyllite<sup>45</sup> and metamorphosed volcanic tuff,<sup>46</sup> ash, and flows are common in places” (USGS, 2015h). Metamorphism in the northern Piedmont has been dated to between 480 and 380 MYA (Allard & Whitney, 1994).
- Bedrock in the Blue Ridge Province dates to the Precambrian Era (older than 542 MYA) (NRCS, 2015g), and has a similar geologic composition to the Piedmont Province, with igneous and metamorphic rocks dominating the landscape (USGS, 2015h). “The degree of metamorphism varies but generally decreases westward” (NRCS, 2015g).
- The Valley and Ridge Province is underlain by folded Paleozoic (542 to 251 MYA) sedimentary rocks, including limestone,<sup>47</sup> shale,<sup>48</sup> and sandstone<sup>49</sup> (USGS, 2015i).
- Within Georgia, the Appalachian Plateaus Province is predominantly underlain by limestone, sandstone, and shale from the Devonian (416 to 359 MYA) and Pennsylvanian (318 to 299 MYA) Periods (USGS, 2015j).

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<sup>39</sup> 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).

<sup>40</sup> Tectonisms: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust” (USGS, 2015e).

<sup>41</sup> Igneous Rock: “Rocks that solidified from molten or partly molten material, such as magma” (USGS, 2005).

<sup>42</sup> 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, 2015g).

<sup>43</sup> Gneiss: “A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals” (USGS, 2015g).

<sup>44</sup> Schist: “Metamorphic rock usually derived from fine-grained sedimentary rock such as shale” (USGS, 2015g).

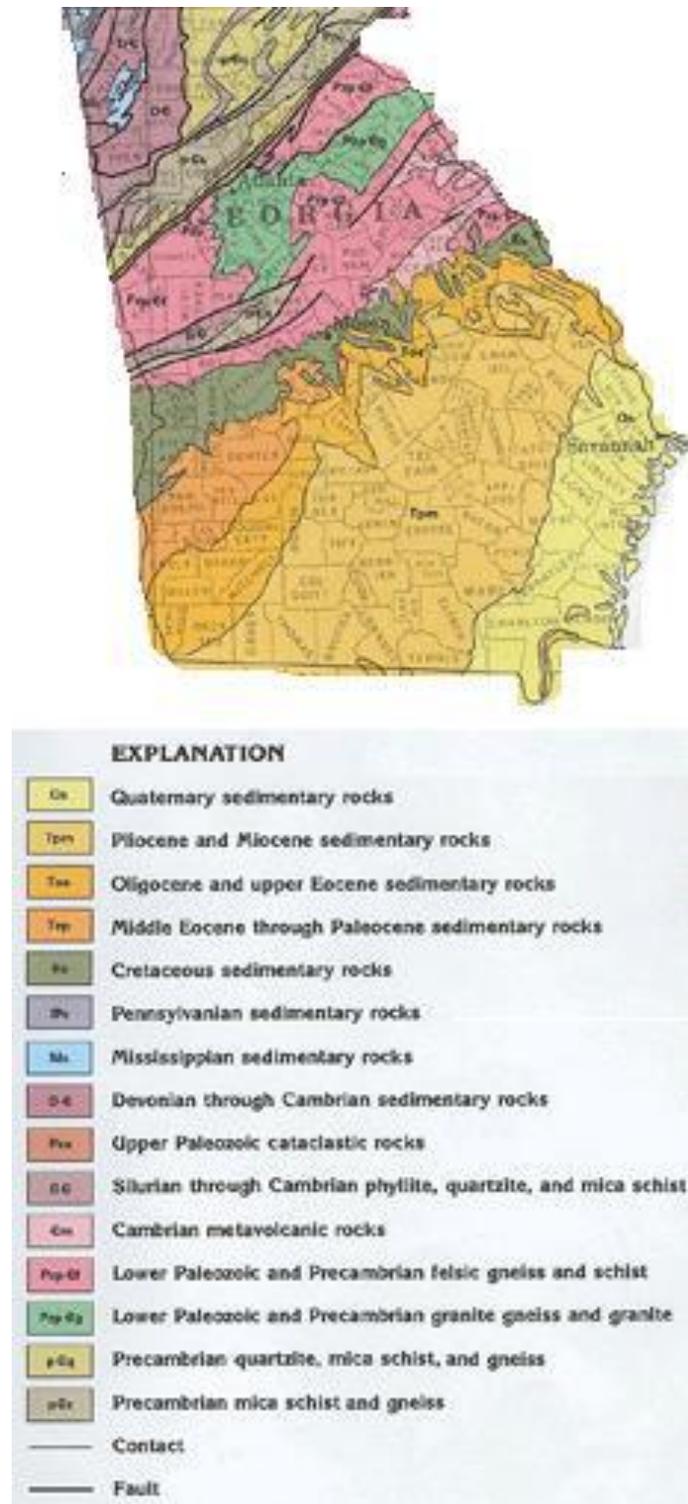
<sup>45</sup> Phyllite: “A very fine-grained, foliated metamorphic rock, generally derived from shale or fine-grained sandstone. Phyllites are usually black or dark gray; the foliation is commonly crinkled or wavy” (USGS, 2015g).

<sup>46</sup> Tuff: “Volcanic rock made up of rock and mineral fragments in a volcanic ash matrix. Tuffs commonly are composed of much shattered volcanic rock glass--chilled magma blown into the air and then deposited” (USGS, 2015g).

<sup>47</sup> 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, 2015g).

<sup>48</sup> 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, 2015g).

<sup>49</sup> Sandstone: “Sedimentary rock made mostly of sand-sized grains” (USGS, 2015g).



Source: (USGS, 2015k)

**Figure 6.1.3-3: Generalized Bedrock Geology for Georgia**

### 6.1.3.6. *Paleontological Resources*

Georgia was covered by seas during the Paleozoic Era (542 to 251 MYA), as evidence by the substantial marine invertebrate fossil record from this time. Marine invertebrate fossils from the Cambrian (542 to 488 MYA) through the Carboniferous Periods (359 to 299 MYA) include brachiopods,<sup>50</sup> bivalves,<sup>51</sup> burrows, trilobites,<sup>52</sup> cephalopods,<sup>53</sup> crinoids,<sup>54</sup> bryozoans,<sup>55</sup> and blastoids. Fern and lycopod tree fossils in coal deposits from the Carboniferous Period have also been recorded. Shallow marine fossils date to the Silurian Period (444 to 416 MYA), while deeper marine fossils are prevalent from the Devonian Period (416 to 359 MYA). Following Permian Period's (299 to 251 MYA) Allegheny orogeny, extensive erosion of the newly raised mountains resulted in sediment deposition in lowlands and subsequent formation of coal deposits and fossil preservation in northwestern Georgia. Fossils from the Cretaceous Period (146 to 66 MYA) are dominated by marine life (The Paleontology Portal, 2015), including the state fossil of Georgia, the shark tooth (GeorgiaInfo, 2015). The Cenozoic Era (66 MYA to present) has been characterized by fluctuating sea levels, with Georgia's southern section's regularly covered by shallow seas. As the Appalachian Mountains eroded, sediment deposition occurred into these sea environments; fossils have been preserved from corals, sea urchins, whales, and the *Carcharodon megalodon* (i.e., giant shark). During the Quaternary Period (2.6 MYA to present), Georgia has been above sea level. Forests and grasslands developed during this time, as evidenced by many large mammal fossils recorded, including mammoths and giant ground sloths (The Paleontology Portal, 2015).



Source: (The Paleontology Portal, 2015)

**Shark Teeth**

### 6.1.3.7. *Fossil Fuel and Mineral Resources*

#### **Oil and Gas**

Georgia does not produce crude oil or natural gas. The state relies on imports of both resources. (EIA, 2015a)

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<sup>50</sup> 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).

<sup>51</sup> Bivalves: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing" (Smithsonian Institution, 2016).

<sup>52</sup> 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).

<sup>53</sup> 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).

<sup>54</sup> 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).

<sup>55</sup> Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies" (Smithsonian Institution, 2016).

## Minerals

As of 2015, Georgia's total nonfuel mineral production was valued at \$1.7B. This ranked 17<sup>th</sup> nationwide (in terms of dollar value), and accounted for 2.18 percent of the total nonfuel mineral production value in the country. As of 2015, Georgia's leading nonfuel mineral commodities were kaolin and Fuller's earth clay, crushed stone, Portland cement, and masonry cement (USGS, 2016a). In 2010 and 2011, Georgia was the country's leading producer of kaolin clay, crude iron oxide pigments, and montmorillonite, and ranked second in production of attapulgite and barite. Other minerals produced in the state (as of 2011) included cement, dimension stone,<sup>56</sup> feldspar, iron oxide, mica, natural gemstones, construction sand and gravel, industrial sand and gravel, and lime (USGS, 2015l).

### 6.1.3.8. *Geologic Hazards*

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

## Earthquakes

Between 1973 and March 2012, there were nine earthquakes of a magnitude 3.5 (on the Richter scale<sup>57</sup>) or greater originating in Georgia, although earthquakes originating outside of Georgia can often be felt in the state (ETK, 2017). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface. Earthquakes can produce secondary flooding impacts resulting from dam failure (USGS, 2012) (FEMA, 2007).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale. Subduction zone earthquakes occur where Earth's tectonic plates collide. "When plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth" (Oregon Department of Geology, 2015). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (Oregon Department of Geology, 2015).

Figure 6.1.3-4 depicts the seismic risk throughout Georgia; 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

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<sup>56</sup> 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).

<sup>57</sup> 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 thirty-fold difference in magnitude. (USGS, 2014b)

50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10% g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60% g. (USGS, 2010)

Areas of greatest seismicity in Georgia are concentrated throughout the northern portions of the state. “Georgia’s northwest counties, South Carolina border counties, and central and west central Georgia counties are most at risk” (GAGOV, 2015). Earthquakes in northwestern Georgia are attributed to the 150-mile long Southeastern Tennessee Seismic<sup>58</sup> Zone, which causes the second largest and second most frequent earthquakes in the eastern half of the country. “This area currently experiences one magnitude 4.0 earthquake about every 10 years” (Long L. T., 1999). Earthquakes are less frequent in Georgia’s Blue Ridge and Piedmont Provinces, and even less frequent in the Coastal Plain. Furthermore, Georgia is at risk due to earthquakes occurring outside of its borders, particularly from the New Madrid Fault Zone (which includes parts of Illinois, Kentucky, Missouri, Tennessee, and Arkansas) and from fault lines near Charleston, South Carolina (Long L. T., 1999).

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<sup>58</sup> Seismic: “Refers to earthquakes” (USGS, 2015g).

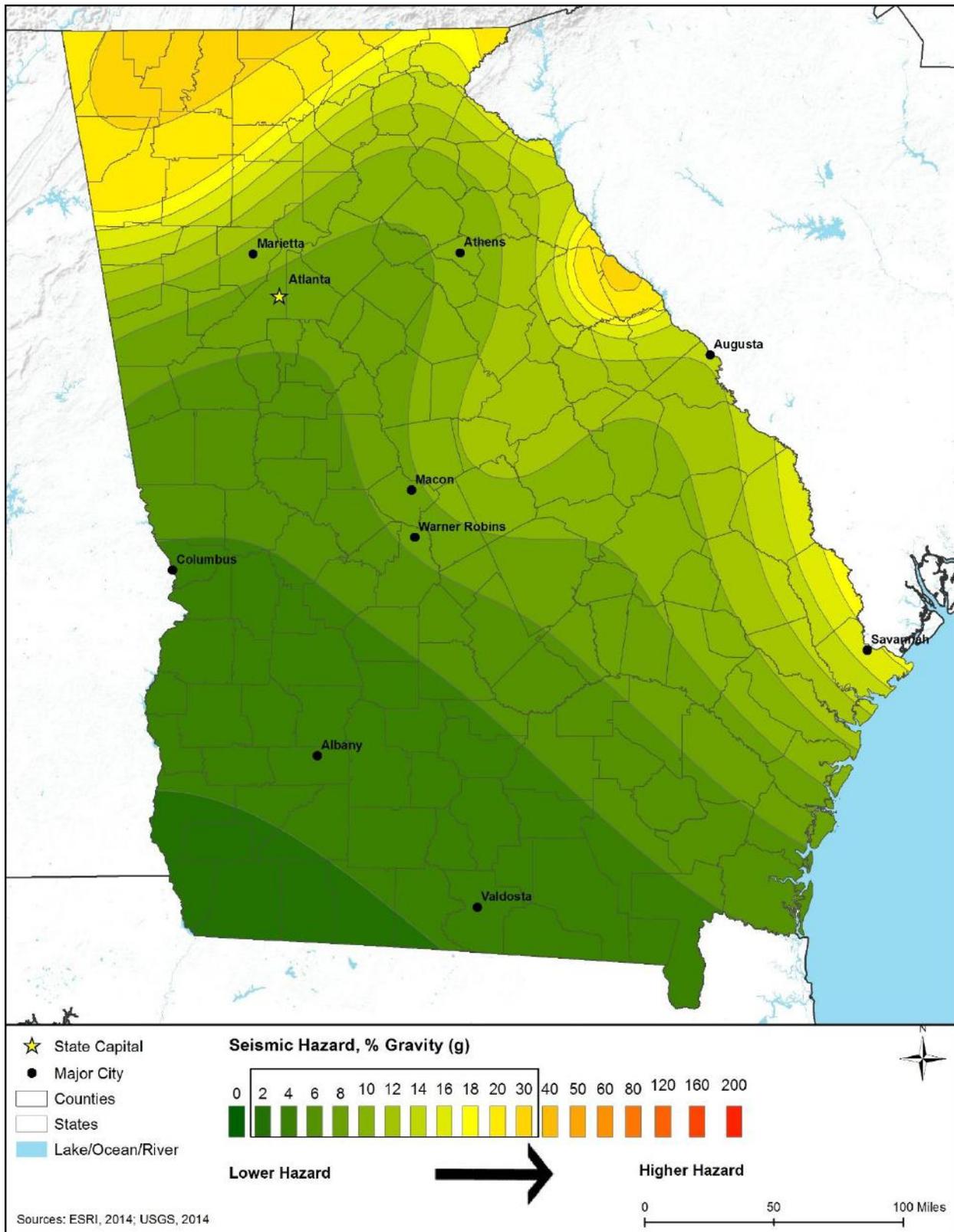


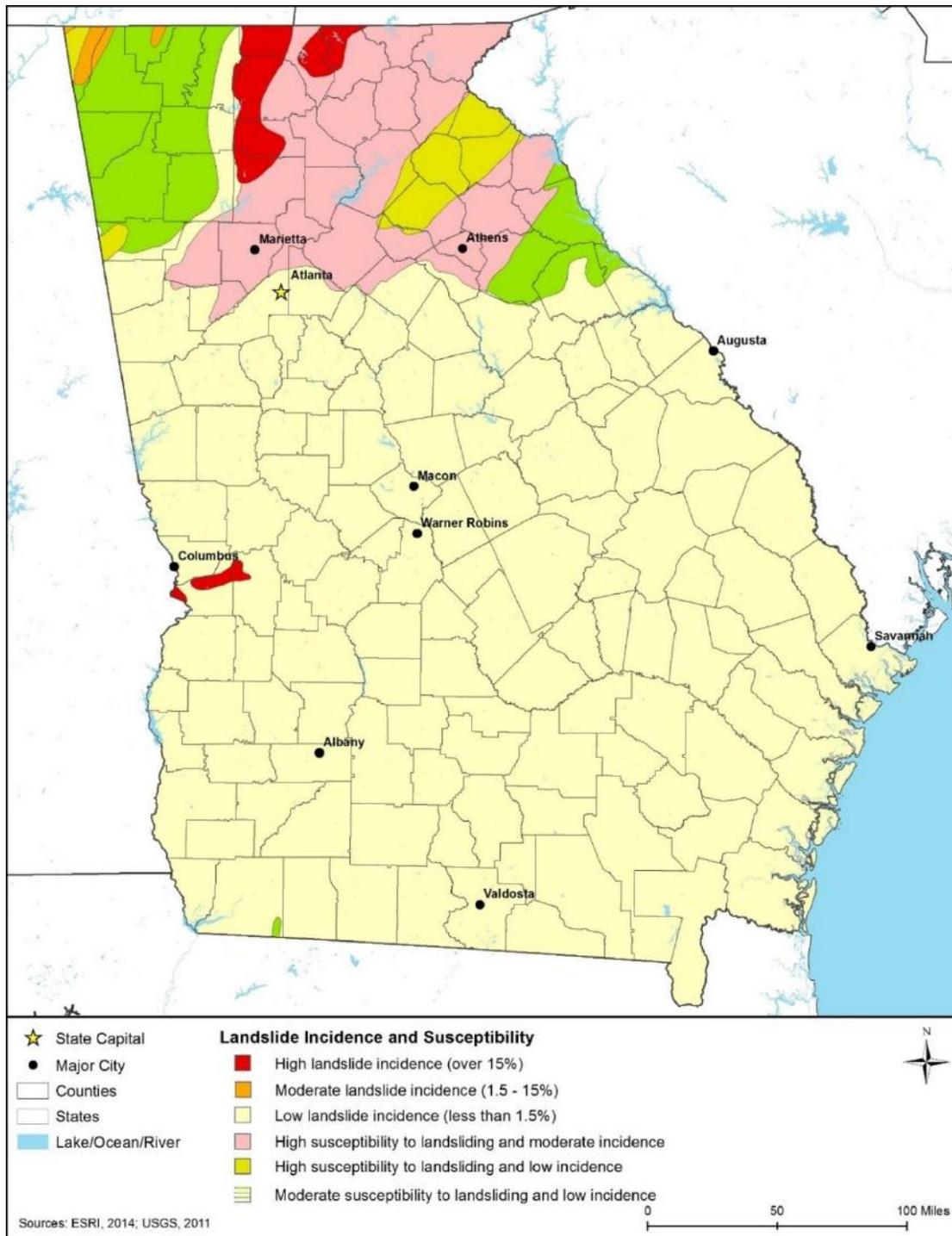
Figure 6.1.3-4: Georgia 2014 Seismic Hazard Map

## **Landslides**

“The term ‘landslide’ describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures” (USGS, 2003b). Geologists use the term “mass movement” to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale. (USGS, 2003b)

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

“High and rounded hills in the interior of the Carolinas and Georgia are covered with thick residual soil and colluvium overlying igneous and metamorphic rocks. The weathered metamorphic rocks, especially mica schist and mica gneiss, are susceptible to earth flows, slumps, and rockslides” (Radbruch-Hall, et al., 1982). The risk of landslides is greatest in Georgia’s Piedmont, Blue Ridge, and Valley and Ridge Provinces, particularly in locations where there has been land disturbance (GAGOV, 2014). Landslides in Georgia also may be triggered by earthquakes (USGS, 1997). Figure 6.1.3-5 shows landslide incidence and susceptibility throughout Georgia.



**Figure 6.1.3-5: Georgia Landslide Incidence and Susceptibility Hazard Map<sup>59</sup>**

<sup>59</sup> Susceptibility hazards not indicated in Figure 6.1.3-6 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014c)

## **Subsidence**

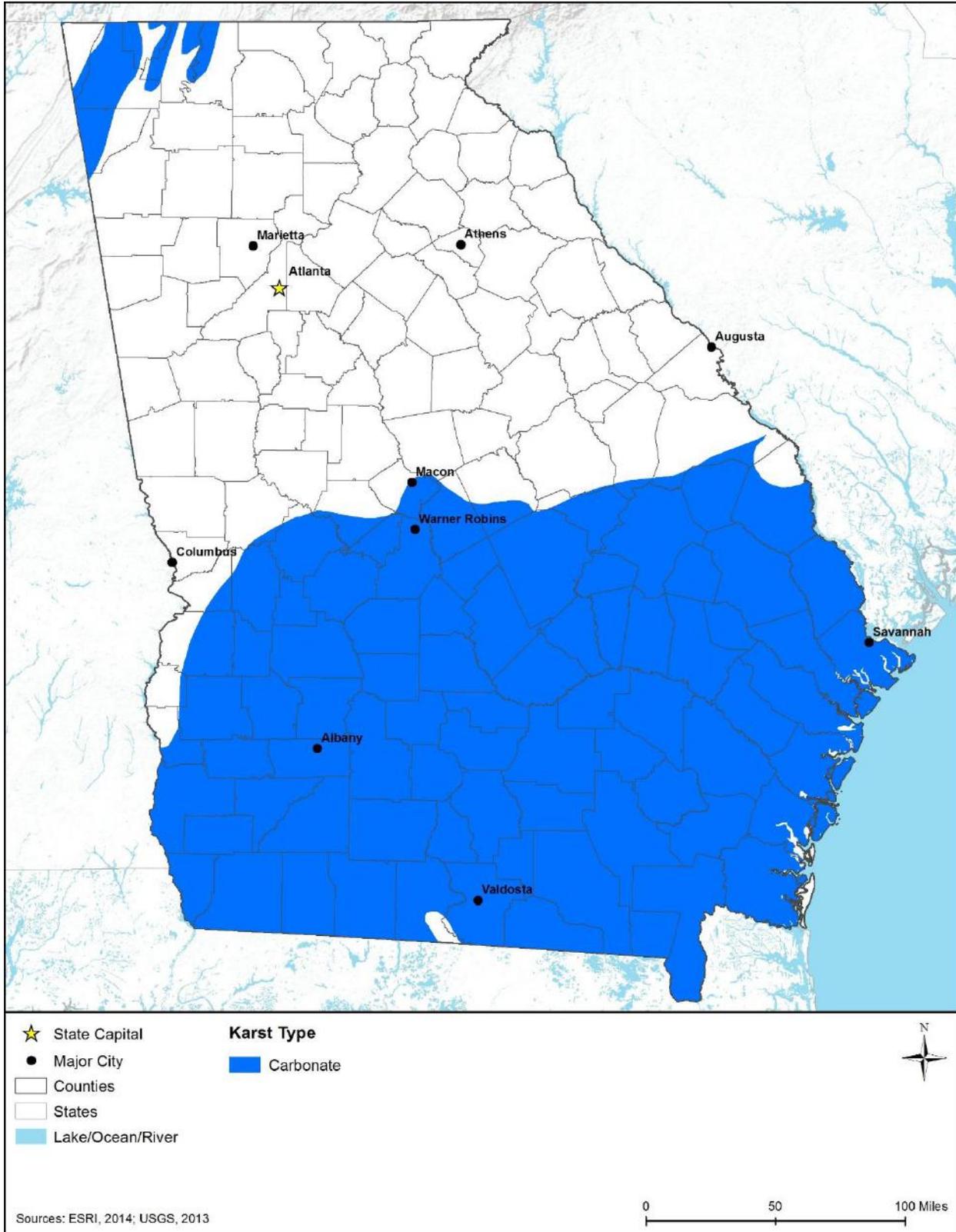
Land subsidence is a “gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials” (USGS, 2000). Portions of Georgia are susceptible to land subsidence owing to karst<sup>60</sup> topography (USGS, 2014d). The primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost (although permafrost is not an issue in Georgia). 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. Lowered terrain is more susceptible to inundation during high tides. Additionally, land subsidence can affect vegetation and land use (USGS, 2013c).

In Georgia, the main causes of land subsidence are sinkholes produced by karst topography (USGS, 2014d). Karst topography is common throughout southern Georgia’s Coastal Plain Province; sinkholes typically form in areas where water enters pore spaces within the underlying limestone (Beck, 1980). Much of Lowndes County (in south-central Georgia) is underlain by limestone (Long D. , 1920), leading to “abundant sinkholes and sinkhole lakes that have formed” (USGS, 2001a). Karst topography also is common in northwestern Georgia in the Valley and Ridge and Appalachian Plateaus Provinces (USGS, 2014d); in these areas, sinkholes and caves typically form as water infiltrates the limestone layers along joints and dissolves underlying rock layers. At 586 feet in length from its leading edge at the ground surface, the deepest karst-produced cave in the country is in northwestern Georgia in an area underlain by Carboniferous Period (359 to 299 MYA) limestone (Beck, 1980). Figure 6.1.3-6 displays the areas of Georgia susceptible to the formation of karst topography.

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<sup>60</sup> Karst: “A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or groundwater” (USGS, 2015g).



**Figure 6.1.3-6: Areas Susceptible to Subsidence due to Karst Topography in Georgia**

## 6.1.4. Water Resources

### 6.1.4.1. Definition of the Resource

Water resources are defined as all surface waterbodies and groundwater systems including streams, rivers, lakes, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 6.1.5). 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, 2014e)

### 6.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 6.1.4-1 summarizes the major Georgia laws and permitting requirements relevant to the state’s water resources.

**Table 6.1.4-1: Relevant Georgia Water Resources Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Section 4 of Georgia’s Rules and Regulations for Water Quality Control (Chapter 391-3-6-.03)	Georgia Environmental Protection Division (GAEPD), Georgia Department of Natural Resources (GADNR)	Defines general water permitting laws in Georgia.
Georgia Pollutant Discharge Elimination System	GAEPD	Discharges to surface waters resulting from construction activities from single projects that disturb one or more acre of surface soil.
		Discharges to surface waters resulting from construction in which a primary permittee uses secondary permittees under a common plan of development that disturbs one or more acres of surface soil.
		Discharges to surface waters resulting from activities to construct infrastructure including installation and maintenance of roadways, cables, and wires.
Coastal Marshlands Protection Act (CMPA)	GADNR	Regulates activities within nearshore areas, beaches, dunes, bluffs, and structural hazard areas.
CWA Section 404 permit, Nationwide Permit, Georgia State Regional Conditions	U.S. Army Corps of Engineers (USACE), Savannah District	GADNR must be notified prior to any dredge or fill activities.
CWA Section 401 permit	GADNR	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 GADNR/GAEPD indicating that the proposed activity will not violate water quality standards.

Source: (GAEPD, 2015e) (GAEPD, 2017a) (GADNR, 2017a) (NCMS, 2017)

### **6.1.4.3. Environmental Setting: Surface Water**

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine<sup>61</sup> and coastal waters. According to the GADNR, Georgia has more than 70,000 miles of rivers and streams, nearly 426,000 acres of lakes, ponds, and reservoirs, over 854 square miles of estuaries, and about 100 miles of coastline. These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, and manufacturing across the state. Georgia's abundant water supplies provide drinking water; recreational areas ideal for swimming, fishing and boating; and water for generating hydroelectric power. (GADNR, 2014)

#### **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). Georgia's waters (lakes, rivers, and streams) are divided into 14 major watersheds, or drainage basins (Figure 6.1.4-1). Georgia has 14 major river basins. These are the Altamaha, Chattahoochee, Coosa, Flint, Ochlockonee, Ocmulgee, Oconee, Ogeechee, St. Mary's, Satilla, Savannah, Suwannee, Tallapoosa, and the Tennessee.<sup>62</sup>

#### **Freshwater**

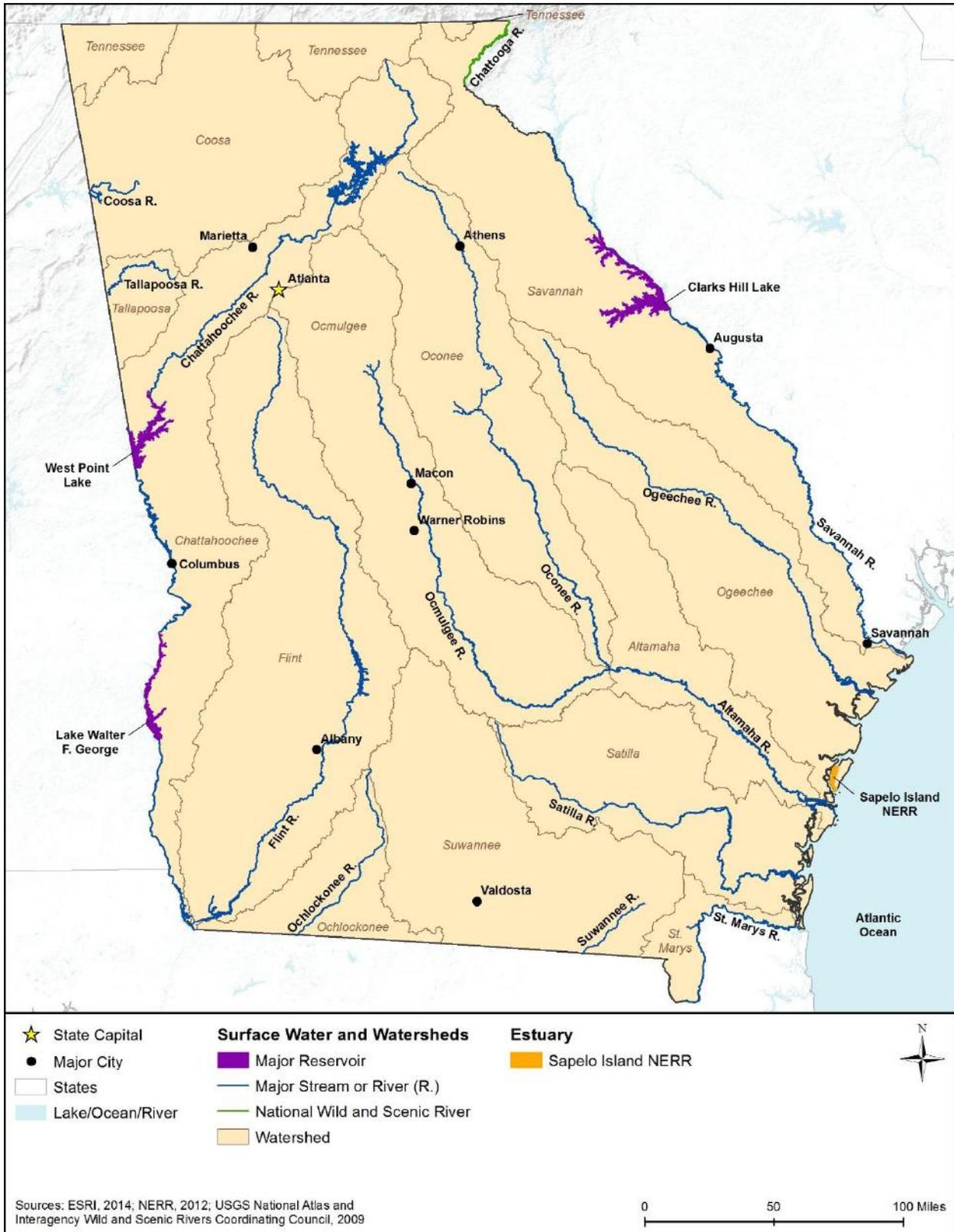
As shown in Figure 6.1.4-1, there are 14 major rivers in Georgia: Altamaha, Chattahoochee, Coosa, Flint, Ochlockonee, Ocmulgee, Oconee, Ogeechee, St. Mary's, Satilla, Savannah, Suwannee, Tallapoosa, and Tennessee rivers. Georgia has 48 lakes that are more than 500 acres each. Clarks Hill Lake is Georgia's largest lake, at 78,000 acres, followed by Lake Hartwell (56,000 acres), and Lake Walter F. George (45,700 acres) (GADNR, 2012). Some of the state's large lakes and dammed reservoirs provide flood control, hydropower<sup>63</sup> generation, and drinking water sources (USEPA, 2009).

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<sup>61</sup> Estuarine: related to an estuary, or a "partially enclosed body of water where fresh water from rivers and streams mixes with salt water from the ocean. It is an area of transition from land to sea" (USEPA, 2015c).

<sup>62</sup> Visit <http://epd.georgia.gov/watershed-assessment-and-protection-plan-guidance-documents> for information and additional maps about each GADNR watershed's location, size, and water quality. (GAEPD, 2017b)

<sup>63</sup> Hydropower: "electrical energy produced by falling or flowing water" (USEPA, 2004).



**Figure 6.1.4-1: Major Georgia Watersheds, defined by GADNR, and Surface Waterbodies**

## **Estuarine and Coastal Waters**

Estuaries (including bays and tidal rivers) are bodies of water that provide transition zones between fresh river water and saline ocean water. Barrier islands, coastal marshes, tidal creeks, and other landmasses protect estuaries, including those in Georgia, from ocean waves and storms. Georgia's estuarine environments support a variety of habitats, including tidal wetlands, mudflats, rocky shores, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the lifecycle of many different plant and animal species. (USEPA, 2012a)

Georgia has 110 linear miles of ocean shoreline and nearly 3,400 miles of tidal estuarine and coastal shoreline stretching from the Savannah River to the north and the St. Mary's River to the south. Impoundment of Georgia's major rivers has reduced sediment input to the coastal sand-sharing system. In addition, construction of sea walls and jetties and dredging of tidal river channels have altered natural sand movement patterns along the coast, resulting in increased erosion of some beaches. Other activities influencing coastal beach and dune habitats include residential and commercial development, vehicular traffic, littering, artificial lighting, and unmanaged recreational use. Protection of these important habitats will require a concerted effort involving state, federal, and local governments as well as local residents, educational groups, and civic organizations. (GADNR, 2005a)

The Sapelo Island National Estuarine Research Reserve lies in the midst of an estuary. Sapelo Island, Georgia's fourth largest barrier island, is located midway on the Georgia coastline and is separated from the mainland by 5 miles of marsh and tidal waterways. Georgia owns most of Sapelo Island, a total of 16,500 acres. The Reserve consists of 6,100 acres of land, 4,000 of which is salt marsh. The reserve is committed to research, education and outreach stewardship, and sound management of coastal resources. (NOAA, 2015a) (GADNR, 2015a)

### ***6.1.4.4. Sensitive or Protected Waterbodies***

#### **Wild and Scenic Rivers**

The Chattooga River is the only federally designated National Wild and Scenic Rivers in Georgia (Figure 6.1.4-1) (see Appendix C, Environmental Laws and Regulations, for more information on the Act). The federally designated segment is 57 miles in length (49.2 miles in Georgia) and is located in the northern portion of the state. The Chattooga River is one of the few remaining free-flowing streams in the Southeast. (NWSRS, 2015)

In 1969, the state legislature passed the Georgia Scenic Rivers Act, based on the federal Wild and Scenic Rivers Act of 1968. The Georgia Scenic Rivers Act established guidelines and criteria for the designation of state Scenic Rivers, and specified certain prohibited acts (channel modification and dam construction) within these streams. The following rivers are designated as scenic under the Georgia Scenic Rivers Act: the portion of the Jacks River contained within the Cohutta National Wilderness Area and located in Fannin and Murray Counties, Georgia, which portion extends a length of approximately 16 miles; the portion of the Conasauga River located within the Cohutta National Wilderness Area and located in Fannin, Gilmer, and Murray Counties, Georgia, which portion extends a length of approximately 17 miles; the portion of the

Chattooga River and its West Fork which are now designated as part of the Chattooga National Wild and Scenic River and located in Rabun County, Georgia, which portion extends a length of approximately 34 miles; and the portion of Ebenezer Creek from Long Bridge on County Road S 393 to the Savannah River and located in Effingham County, Georgia, which portion extends a length of approximately seven miles. (GADNR, 2005a)

### **High Priority Waters**

Georgia identified high priority waters for protecting aquatic biodiversity as part of its comprehensive wildlife conservation strategy development. There are 212 high priority waters in the state, selected to protect or restore important aquatic systems throughout Georgia. To view the list or map all 212 high priority waters, visit [www.georgiawildlife.com/node/1377](http://www.georgiawildlife.com/node/1377). (GADNR, 2015b)

#### **6.1.4.5. 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,<sup>64</sup> the causes of impairment, and probable sources. Table 6.1.4-2 summarizes the water quality of Georgia's assessed major waterbodies by category, percent impaired, designated use,<sup>65</sup> cause, and probable sources. Figure 6.1.4-2 shows the Section 303(d) waters in Georgia as of 2012.

As shown in Table 6.1.4-2, nonpoint source pollution<sup>66</sup> is the most probable source for impairment in Georgia's surface waterbodies. Rivers and streams in the state were generally poor quality, with pathogens and dissolved oxygen being the top causes of impairment. Lakes, reservoirs, and ponds were rated fair quality; polychlorinated biphenyls, pH, and algal growth were the top causes of impairment (USEPA, 2015c). Georgia has six large publicly owned lakes that have specific water quality standards, West Point, Jackson, Walter F. George, Lanier, Allatoona, and Carter's. Standards were adopted for pH, nutrients, fecal coliform bacteria, dissolved oxygen, and temperature (GADNR, 2012). Georgia's estuaries, bays, and coastal shoreline are generally rated good quality, and support their primary designated use of fishing (USEPA, 2015c).

GADNR is focusing its pollution reduction efforts on pathogens (fecal coliform), fish biota (sediment), dissolved oxygen, metals, and nutrients. In addition, GADNR is focusing its water quality efforts on the main source of pollution affecting Georgia surface waters--nonpoint pollution. Potential sources include mud, litter, bacteria, pesticides, fertilizers, metals, oils,

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<sup>64</sup> Impaired waters: Waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters (USEPA, 2015c).

<sup>65</sup> Designated Use: An appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply (USEPA, 2015c).

<sup>66</sup> Nonpoint source pollution: A source of pollution that does not have an identifiable, specific physical location or a defined discharge point. Non-point source pollution includes nutrients that run off croplands, lawns, parking lots, streets and other land uses. It also includes nutrients that enter waterways via air pollution groundwater, or septic systems. (USEPA, 2015c)

detergents, and other pollutants washed into rivers and lakes by stormwater. Even stormwater runoff itself, if rate and volume is uncontrolled, can be extremely detrimental to aquatic habitat systems. (GADNR, 2012)

**Table 6.1.4-2: Section 303(d) Impaired Waters of Georgia, 2012**

<b>Water Type<sup>a</sup></b>	<b>Amount of Waters Assessed<sup>b</sup> (Percent)</b>	<b>Amount Impaired (Percent)</b>	<b>Designated Uses of Impaired Waters</b>	<b>Top Causes of Impairment</b>	<b>Top Probable Sources for Impairment</b>
Rivers and Streams	20%	59%	coastal fishing, drinking water supply, fishing, and recreation	pathogens <sup>c</sup> (fecal coliform), unknown/impaired biota, dissolved oxygen	nonpoint source, urban-related runoff/stormwater, industrial/commercial site stormwater discharge (permitted), and municipal point source discharges
Lakes, Reservoirs, and Ponds	85%	36%	drinking water, fishing, and recreation	polychlorinated biphenyls (PCBs), pH, acidic substances, algal growth, and mercury	nonpoint source, industrial/commercial site stormwater discharge (permitted), and urban runoff/storm sewers
Estuaries and Bays	8%	6%	coastal fishing	dissolved oxygen	industrial point source discharge, municipal point source discharges, and urban runoff/storm sewers
Coastal shoreline	34.3 miles <sup>d</sup>	9%	fishing and recreation	pathogens	non-point source

Source: (USEPA, 2015c)

<sup>a</sup> Some waters may be considered for more than one water type.

<sup>b</sup> Georgia has not assessed all waterbodies within the state.

<sup>c</sup> Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015c).

<sup>d</sup> Value not represented in percent because total size of coastal shoreline is not available (USEPA, 2015c).

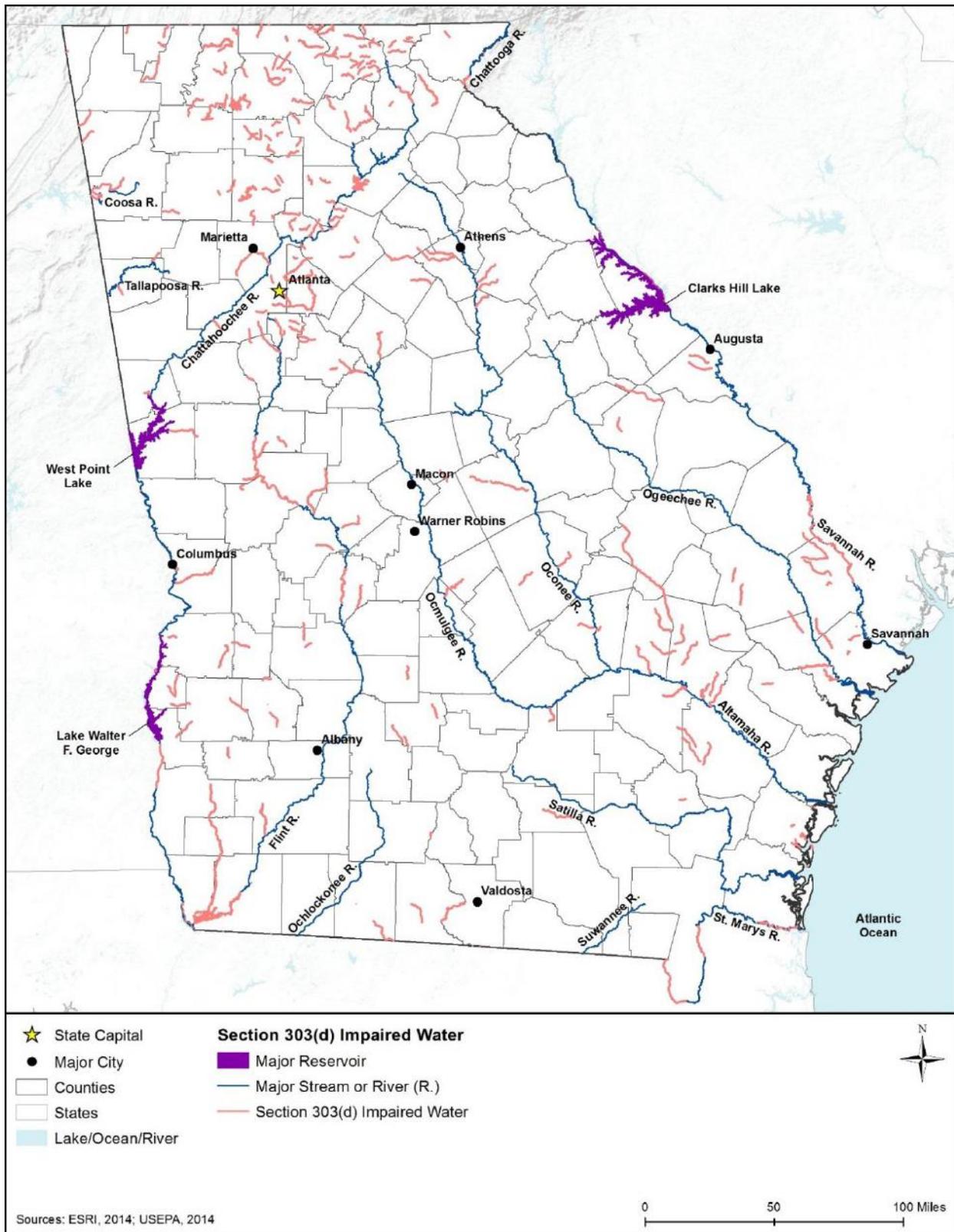


Figure 6.1.4-2: Section 303(d) Impaired Waters of Georgia, 2014

#### **6.1.4.6. 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).<sup>67</sup> 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)

There are two primary types of floodplains in Georgia:

- **Riverine floodplains** occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous 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)
- **Coastal floodplains** in Georgia border the coastline and barrier islands. Coastal flooding can occur when strong wind and storms from severe storms, usually hurricanes in Georgia, increase water levels on the adjacent shorelines. (FEMA, 2013)

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, 2015b). There are several causes of flooding in Georgia, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, hurricanes, over-development/impervious<sup>68</sup> surfaces, loss of wetlands, and climate change (GEMA, 2014).

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance,

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<sup>67</sup> To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): [www.ecfr.gov](http://www.ecfr.gov).

<sup>68</sup> 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, 2015c).

including mapping of 100-year floodplain limits, to approximately 550 communities in Georgia through the National Flood Insurance Program (NFIP) (FEMA, 2015a). 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, 2015b). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Georgia had 46 communities participating in the CRS (FEMA, 2014c).<sup>69</sup>

#### **6.1.4.7. Groundwater**

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface, and includes underground water that occupies pore spaces between sand, clay, or rock particles. An aquifer is a permeable geological formation that stores or transmits water to wells and springs. Groundwater is contained in either confined (bound by clays or nonporous bedrock) or unconfined (no layer to restrict the vertical movement of groundwater) aquifers. When the water table reaches the ground surface, groundwater will reappear as either streams, surface bodies of water, or wetlands. This exchange between surface water and groundwater is an important feature of the hydrologic (water) cycle. (USGS, 1999)

Groundwater in Georgia is generally good for all uses and abundant. All of the state’s aquifers are suitable sources for drinking water; the only potential issue is the Southeastern Coastal Plain aquifer, which can be impacted from saltwater intrusion (saltwater moving into freshwater aquifers). In the rural areas of the state, groundwater is main source of drinking water. Statewide, the most serious threats to groundwater quality include leaking underground storage tanks, inadequate or failing onsite septic systems, discharge from landfills, hazardous waste sites and industrial facilities, urban runoff, chemical spills, natural iron and manganese, and saltwater intrusion. (GADNR, 2012)

Table 6.1.4-3 provides details on aquifer characteristics in the state; Figure 6.1.4-3 shows Georgia’s principal aquifers. There are no sole source aquifers within the state (USEPA, 2013b). The Pennsylvanian aquifer is in a small portion of northern part of the state, as shown in Figure 6.1.4-3. This aquifer is more extensive in other states and represents a relatively small area within Georgia, and thus is not discussed in detail.

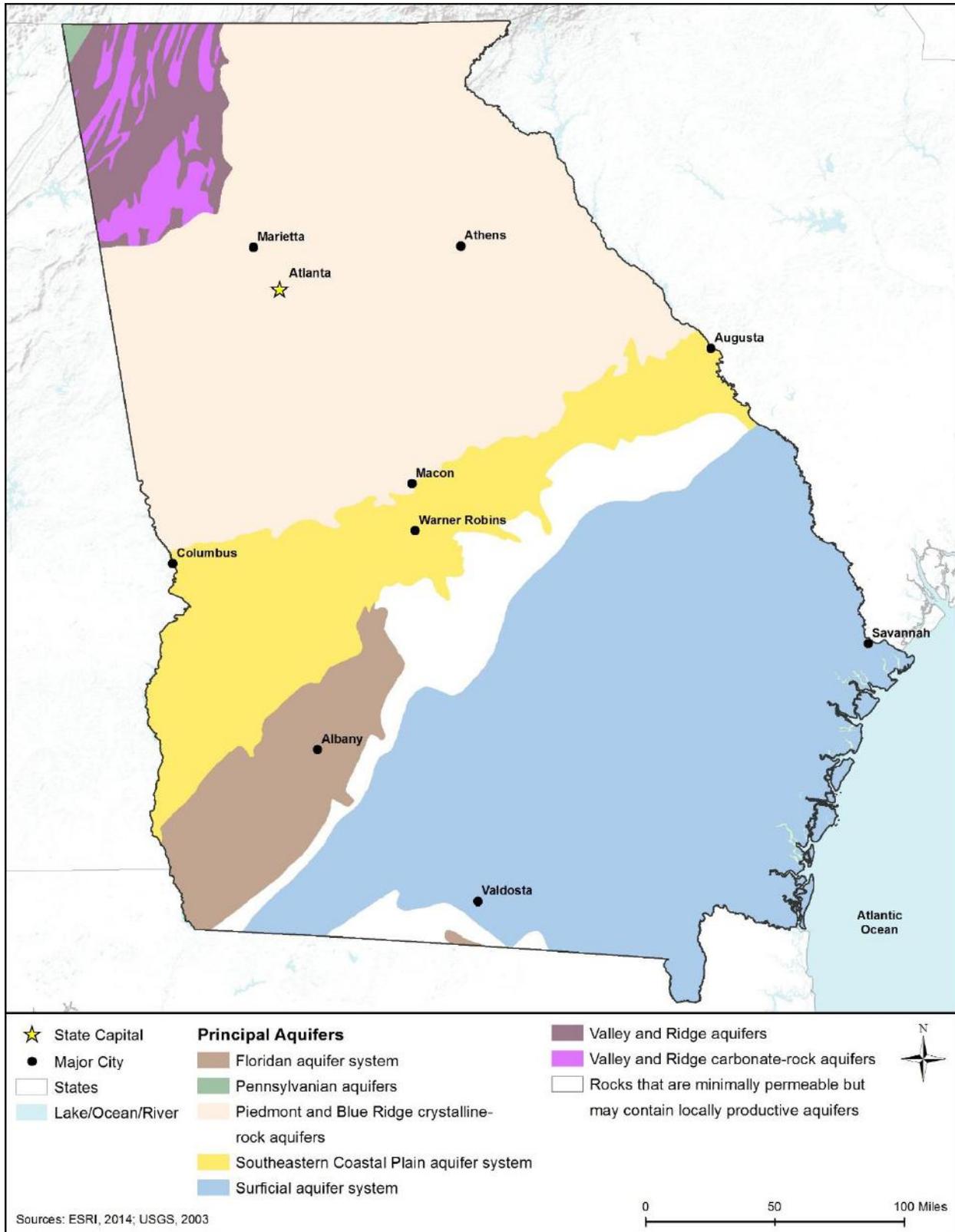
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<sup>69</sup> A list of the 46 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014c) and additional program information is available from FEMA’s NFIP CRS website ([www.fema.gov/national-flood-insurance-program-community-rating-system](http://www.fema.gov/national-flood-insurance-program-community-rating-system)).

**Table 6.1.4-3: Description of Georgia’s Principal Aquifers**

Aquifer Type and Name	Location in State	Groundwater Quality
<b>Floridan</b> Consists of a sequence of carbonate rocks.	Southwestern	Susceptible to salt-water intrusion, especially along the coast. As one of the most productive aquifers in the world, it is a primary source of drinking water and industrial process water throughout coastal Georgia. Dissolved solid concentrations can be high from the mixing of fresh groundwater with saltwater.
<b>Surficial Aquifer System</b> Consists of unconsolidated sand, shells, and shelly sand	Southern quarter of state	Dissolved solid concentrations range up to 150 milligrams per liter (mg/L). Water is slightly acidic.
<b>Valley and Ridge aquifers</b> Carbonate rocks, shale, sandstone, and some coal-bearing beds.	Northwestern corner	Water quality is generally sufficient for drinking and other uses. Dissolved solid concentrations average about 150 mg/L. Water contains calcium bicarbonate. Water is moderately hard and slightly basic.
<b>Valley and Ridge carbonate-rock aquifers</b> Composed mostly of limestone.	Northwestern corner	Water quality is generally sufficient for drinking and other uses. Water contains calcium and magnesium carbonate and dissolved solid concentrations average about 330 mg/L. The water is very hard and slightly basic.
<b>Piedmont and Blue Ridge crystalline-rock aquifers</b> Crystalline metamorphic and igneous (volcanic) rocks	Northern half	Water quality is generally sufficient for drinking and other uses. The water is soft and slightly acidic.
<b>Southeastern Coastal Plain Aquifer System</b> Semiconsolidated sand; coarse and fine-grained sands.	Band across the center of the state	Generally, the water is suitable for most uses, including drinking water. The water can be salty as it is close to coast or deeper within aquifer.

Source: (Moody, Carr, Chase, & Paulson, 1986), (Olcott, 1995a), (Olcott, 1995b) (USGS, 1995a) (USGS, 1995b), (Miller, 1990)



**Figure 6.1.4-3: Principal Aquifers of Georgia**

## 6.1.5. Wetlands

### 6.1.5.1. Definition of the Resource

The 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, 2017a). 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, 2017a)

### 6.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, explains the pertinent federal laws to protecting wetlands in detail. Table 6.1.5-1 summarizes the major Georgia state laws and permitting requirements relevant to the state’s wetlands.

**Table 6.1.5-1: Relevant Georgia Wetlands Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Georgia Pollutant Discharge Elimination System Program	GAEPD	Discharges to surface waters resulting from construction activities from single projects that disturb one or more acre of surface soil.
		Discharges to surface waters resulting from construction in which a primary permittee uses secondary permittees under a common plan of development that disturbs one or more acres of surface soil.
		Discharges to surface waters resulting from activities to construct infrastructure including installation and maintenance of roadways, cables, and wires.
CWA Section 404 permit, Georgia regional requirements	USACE, Savannah District	GADNR must be notified prior to beginning work on any all NWP authorized projects. A preconstruction notice (PCN) is required for use of NWPs 3(a), 3(c), 5, 6, 13, 19 and 41 for impacts to 0.1 acre or more of wetlands/open water and/or 100 linear feet or more of stream.
CWA Section 401	GADNR	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 GADNR/GAEPD indicating that the proposed activity will not violate water quality standards.

State Law/Regulation	Regulatory Agency	Applicability
Coastal Marshlands Protection Act (O.C.G.A. 12-5-280, et seq.) (1970)	GADNR/Coastal Resources Division	Permit required for structures or activities in coastal marshes. <sup>a</sup>
Georgia Administrative Procedures Act (O.C.G.A. 50-16-61, et seq.) (1863)	GADNR	Requires Permit from GADNR/CRD for tidal water bottoms. Revocable licenses are issued by other agencies throughout the state for resource management. The Act also establishes requirements for public hearings, etc.

Source: (GAEPD, 2017a) (NCMS, 2017) (GADNR, 2017a) (GADNR, 2017b)

<sup>a</sup> “Coastal marshlands” include “[a]ny intertidal marshland area, mud flat, tidal water bottom, or salt marsh in the state of Georgia within the estuarine areas of the state.” “Vegetated marshlands” are “areas upon which grow one, but not necessarily all, of the following: salt marsh grass (*Spartina alterniflora*), black needlerush (*Juncus roemerianus*), saltmeadow cordgrass (*Spartina patens*), big cordgrass (*Spartina cynosuroides*), saltgrass (*Distichlus spicata*), coast dropseed (*Sporobolus virginicus*), bigelow glasswort (*Salicornia bigelovii*), woody glasswort (*Salicornia virginica*), saltwort (*Batis maritima*), sea lavender (*Limonium nashii*), sea oxeye (*Borichia frutescens*), silverling (*Baccharis halimifolia*), false willow (*Baccharis angustifolia*), and high-tide bush (*Iva frutescens*).” “Estuarine areas” include “[a]ll tidally influenced waters, marshes, and marshlands lying within a tide elevation range from 5.6 feet above mean tide level and below.” (GA. CODE ANN. § 12-5-282)

### 6.1.5.3. 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 by Cowardin et al. (Cowardin, Carter, Golet, & LaRoe, 1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 6.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFWS, 2015a)

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

- “Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent.” The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013)

In Georgia, the two main types of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state, and estuarine/marine (tidal) wetlands along Georgia’s coastline, as shown in Figure 6.1.5-1. Riverine (0.2 percent) and lacustrine (1 percent) wetlands compose approximately one percent (37,031 acres) of the total wetlands in the state. Therefore, they are not discussed in this PEIS.

Table 6.1.5-2 uses 2014 NWI data to characterize and map Georgia wetlands on a broad-scale.<sup>70</sup> 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 required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work, at the site-specific level once those locations are known. The map codes and colorings in Table 6.1.5-2 correspond to the wetland types in the figures.

**Table 6.1.5-2: Georgia Wetland Types, Descriptions, Location, and Amount, 2014**

Wetland Type	Map Code and Color	Description <sup>a</sup>	Occurrence	Amount (acres) <sup>b</sup>
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.	Forested lowlands within the state	4,441,697
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state, often on river and lake floodplains	
Palustrine emergent wetlands	PEM	Palustrine emergent 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, <sup>c</sup> prairie potholes, and sloughs. <sup>d</sup>	Throughout the state and Coastal Plains (southeastern part of the state)	255,627

<sup>70</sup> 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.

Wetland Type	Map Code and Color	Description <sup>a</sup>	Occurrence	Amount (acres) <sup>b</sup>
Palustrine unconsolidated bottom	PUB	PUB and PAB 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 and Coastal Plains (southeastern part of the state)	219,798
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, <sup>c</sup> and other miscellaneous wetlands are included in this group.	Throughout the state	2,003
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	10,180
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	26,851
Estuarine and Marine intertidal wetland	E2/M2	These intertidal wetlands include the areas between the highest tide level and the lowest tide level. Semidiurnal tides (two high tides and two low tides per day) periodically expose and flood the substrate. Wetland examples include vegetated and non-vegetated brackish (mix of fresh and saltwater), and saltwater marshes, shrubs, beaches, sandbars, or flats.	Along the Atlantic coastline	364,800
<b>TOTAL</b>				<b>5,320,956</b>

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

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

<sup>b</sup> 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)

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

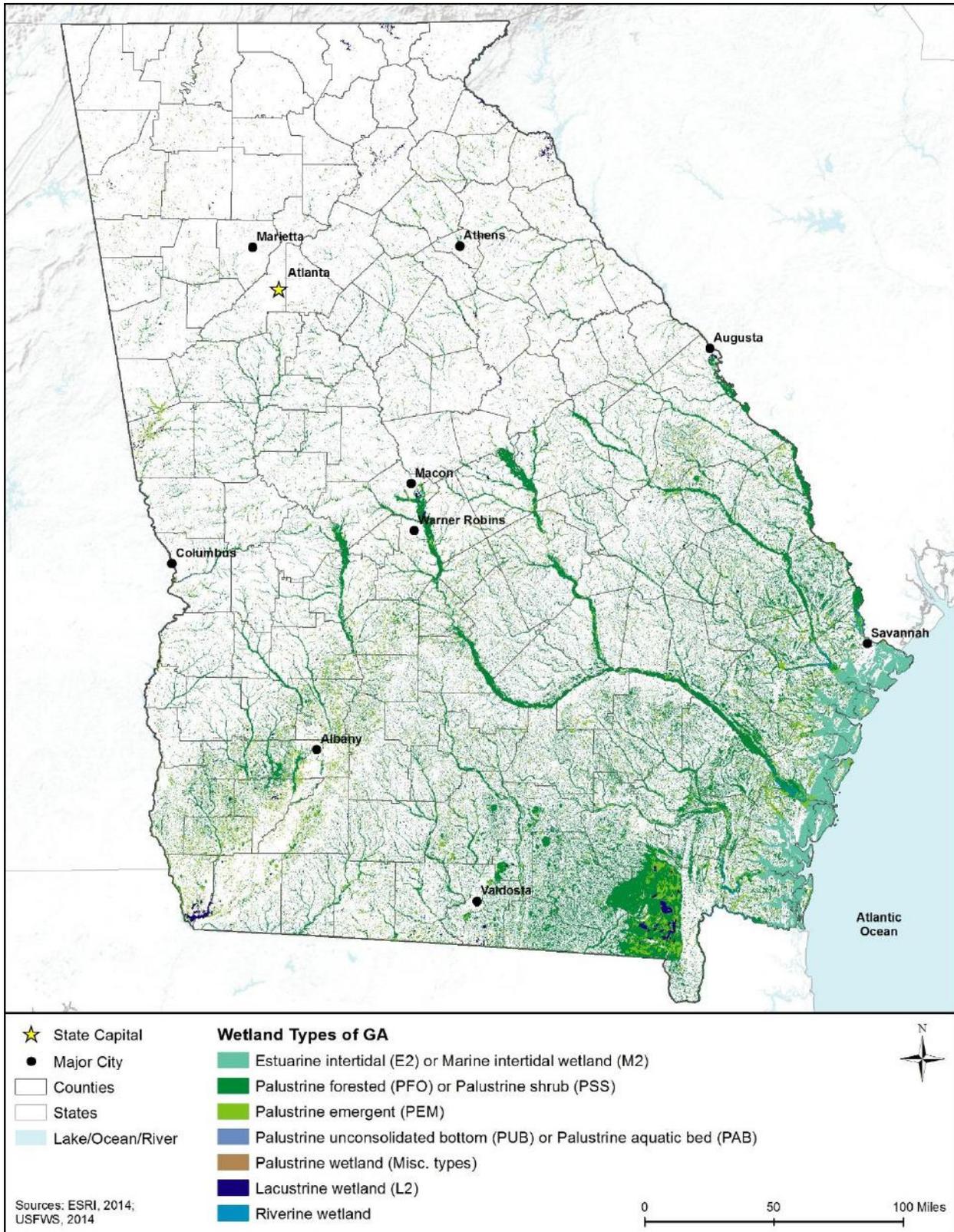
<sup>d</sup> Slough: "Swamp or shallow lake system, usually a backwater to a larger body of water" (NOAA, 2014a).

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

## Palustrine Wetlands

In Georgia, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, bogs, and ponds). They are located throughout the state, and typically found in floodplains along stream channels and in bottomlands. Palustrine wetlands found in Georgia include bottomland forests, river swamp forests or floodplain forests of bald cypress (*Taxodium distichum*), black gum (*Nyssa sylvatica*), overcup oak (*Quercus lyrata*), and swamp tupelo (*Nyssa aquatic*). Other palustrine wetlands include isolated inland wetlands, with cypress ponds, freshwater prairies, hillside seeps, and depressional wetlands, such as Carolina Bays. Interdunal swales are found along the Atlantic coast, in topographic hollows within the sand dunes, and include palustrine emergent and scrub-shrub wetlands. (GADNR, 2005a) (GADNR, Coastal Resources Division, 2011)

Palustrine wetlands also include the shallow water zones of lakes, rivers, and ponds and aquatic beds formed by water lilies and other floating-leaved or free-floating plants. These are the easiest wetlands to recognize and occur throughout the state. (GADNR, 2005a)



**Figure 6.1.5-1: Wetlands by Type, in Georgia, 2014**

## **Estuarine and Marine Wetlands**

In Georgia, estuarine, or tidal fringe wetlands, can be vegetated (marshes) or unvegetated (mud and sand flats), and are found between the open saltwater of the bays or Atlantic Ocean and the uplands of the coastal plain and barrier islands. Estuarine wetlands include coastal salt marshes (tidally flooded grasslands), intertidal areas, and tidal water bottoms. (GADNR, 2005a)

These tidal wetlands provide important habitat for shellfish and fishes, as well as migratory shorebirds and various waterfowl. Tidal marshes are typically found along river systems between freshwater and salt marsh. They have varying salinity levels, and provide habitat for numerous aquatic waterfowl and animals. Tidal salt marshes have the highest salinity of tidal marshes. Vegetation in these swamps is usually very diverse with both tidal marsh and freshwater swamp species. Tidal swamp types found in Georgia include tidal hardwood swamps, tidal bald cypress-tupelo swamps, shrub swamps, and estuarine fringe swamps. (GADNR, 2005a) (GADNR, Coastal Resources Division, 2015)

Georgia's coastline is one hundred miles long and contains almost one-third of the remaining tidal marsh in the eastern United States. The rare landscapes and ecosystems of coastal Georgia are threatened by increasing development in the 11 coastal counties, and by nonpoint source pollution carried in rivers and streams flowing into those counties. (GADNR, 2005a) (GADNR, Coastal Resources Division, 2011)

### **Status and Trends**

Georgia's historic wetland acreage were estimated from "4.9 to 7.7 million acres, including more than 600,000 acres of open water habitat found in estuarine, riverine, palustrine, and lacustrine environments" (GADNR, 2005a). Approximately 78,000 acres of wetlands were lost from 1975 to 1982, according to GADNR (GADNR, 2005a). Based on the USFWS NWI 2014, Georgia has more than 5.3 million acres of wetlands, with approximately 4.9 million acres of palustrine wetlands (USFWS, 2017a). Of the palustrine wetlands, PFO/PSS is the dominant wetland type (90 percent), followed by PEM (5 percent), PUB/PAB (ponds) (4 percent), and other palustrine wetlands (1 percent) (USFWS, 2017a). Main threats to palustrine wetlands in Georgia include silviculture (tree harvesting), agricultural conversion, and urbanization and associated impacts (road construction) (GADNR, 2015c).

#### ***6.1.5.4. Important Wetland Sites in Georgia***

The Okefenokee Swamp is a mix of forested swamp and freshwater marsh in southern Georgia and north Florida. The swamp drains to the south and southwest and contains the headwaters for the St. Mary's and Suwannee Rivers as well as numerous islands, lakes, and thick beds of peat. Cypress, swamp blackgum, and pine forests are common, as well as grasses, sedges, and various aquatic plants (GADNR, 2005a). More information on the Okefenokee Swamp is in Section 5.1.5, Florida Water resources.

Wildlife Management Areas (WMA) are public areas available for recreation. Georgia has more than 20 properties with wetland and stream habitat. Sites include the Altamaha WMA, River Creek WMA, Oaky Woods WMA, Silver Lake WMA, Paulding Forest WMA, and Townsend

WMA. Visit <http://www.georgiawildlife.com/hunting/wildlife-management-areas> to learn more about WMAs in Georgia. (GADNR, 2015c)

Georgia has 11 designated National Natural Landmarks, ranging in size from 300 acres to nearly 370,000 acres, which are owned by GADNR, The Nature Conservancy, USFWS, counties, municipalities, and other conservation organizations and individuals. Wetland sites include Big Hammock Natural Area, Ebenezer Creek Swamp, and Okefenokee Swamp (NPS, 2015b). Section 6.1.8, Visual Resources, describes Georgia'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 Agricultural Conservation Easement Program, The Nature Conservancy, The Conservation Fund, The Georgia Land Trust, and Ducks Unlimited. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (<http://conservationeasement.us/>), Georgia Land Trust holds almost 164,000 acres in conservation easements in Georgia. (NCED, 2015)

## **6.1.6. Biological Resources**

### ***6.1.6.1. Definition of the Resource***

This section describes the biological resources of Georgia. Biological resources include terrestrial<sup>71</sup> vegetation, wildlife, fisheries and aquatic<sup>72</sup> habitats,<sup>73</sup> and threatened<sup>74</sup> and endangered<sup>75</sup> species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Because of the topographical variation in the state, from the Blue Ridge Mountains located north of the Fall Line<sup>76</sup> to the flat plains in the south, Georgia supports a wide diversity<sup>77</sup> of biological resources including spruce-fir forests, heath balds, pine flatwoods, and estuarine and saltwater marshes. Each of these topics is discussed in more detail below.

### ***6.1.6.2. Specific Regulatory Considerations***

The federal laws relevant to the protection and management of biological resources in Georgia are summarized in detail in Appendix C, Environmental Laws and Regulations, and Section 1.8,

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<sup>71</sup> Terrestrial: "Pertaining to land" (USEPA, 2015d).

<sup>72</sup> Aquatic: "Pertaining to water" (USEPA, 2015d).

<sup>73</sup> Habitat: "The environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal" (USEPA, 2015d).

<sup>74</sup> 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)).

<sup>75</sup> 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)).

<sup>76</sup> Fall Line: "the geologic boundary that separates the soft sediments of the Coastal Plain physiographic province from the hard bedrock of the Piedmont physiographic province...the Fall Line extends from New York to Georgia" (VirginiaPlaces.org, 2016).

<sup>77</sup> Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015d).

Overview of Relevant Federal Laws and Executive Orders. Table 6.1.6-1 summarizes major state laws relevant to Georgia’s biological resources.

**Table 6.1.6-1: Relevant Georgia Biological Resources Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Endangered Wildlife Act of 1973 (Official Code of Georgia Annotated [OCGA] 27-3-130)	GADNR	Requires identification, inventory, and protection of rare or unusual animal species or animal species that are in danger of extinction.
Nongame Wildlife Conservation Programs Act of 1985 (OCGA 12-3-600)	GADNR	Establishes nongame wildlife and habitat conservation programs and makes encouraging and enabling voluntary citizen support of these programs an official state policy.
Georgia Natural Areas Act (OCGA 12-3-90)	GADNR	Allows for identification and acquisition of areas of unusual ecological significance for scientific study, “serve as examples of nature to the general public,” and “enrich the quality of our environment for present and future generations.”
Coastal Marshlands Protection Act of 1970 (OCGA 12-5-280)	GADNR	Established the Coastal Marshlands Protection Committee and which oversees marshland alteration permitting. Requires a permit for any of the following activities in coastal marshlands: filling, draining, dredging, or otherwise altering.
Wildflower Preservation of 1973 (OCGA 12-6-170)	GADNR	Gives GADNR authority to list plants as protected and authorizes rules for collection, transport, and sale of these plants.

Source: (Michigan State University, 2016) (GADNR, 2005b)

### 6.1.6.3. Terrestrial Vegetation

The distribution of flora<sup>78</sup> within the state is a function of the characteristic geology,<sup>79</sup> soils, climate,<sup>80</sup> and water of a given geographic area and correlates with distinct areas identified as ecoregions.<sup>81</sup> Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (NWF, 2015) (USDA, 2015a) (WWF, 2015). Ecoregion boundaries often coincide with physiographic<sup>82</sup> regions of a state. In Georgia, the two main physiographic regions are the Atlantic Plain in the southern half of the state and the Appalachian Highlands in the northern half of the state (Fenneman, 1916).

<sup>78</sup> The plants of a particular region, habitat, or geological period.

<sup>79</sup> 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 groundwater availability.

<sup>80</sup> 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, 2016a).

<sup>81</sup> Ecoregion: “A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables” (USEPA, 2015d).

<sup>82</sup> Physiographic: “The natural, physical form of the landscape” (USEPA, 2015d).

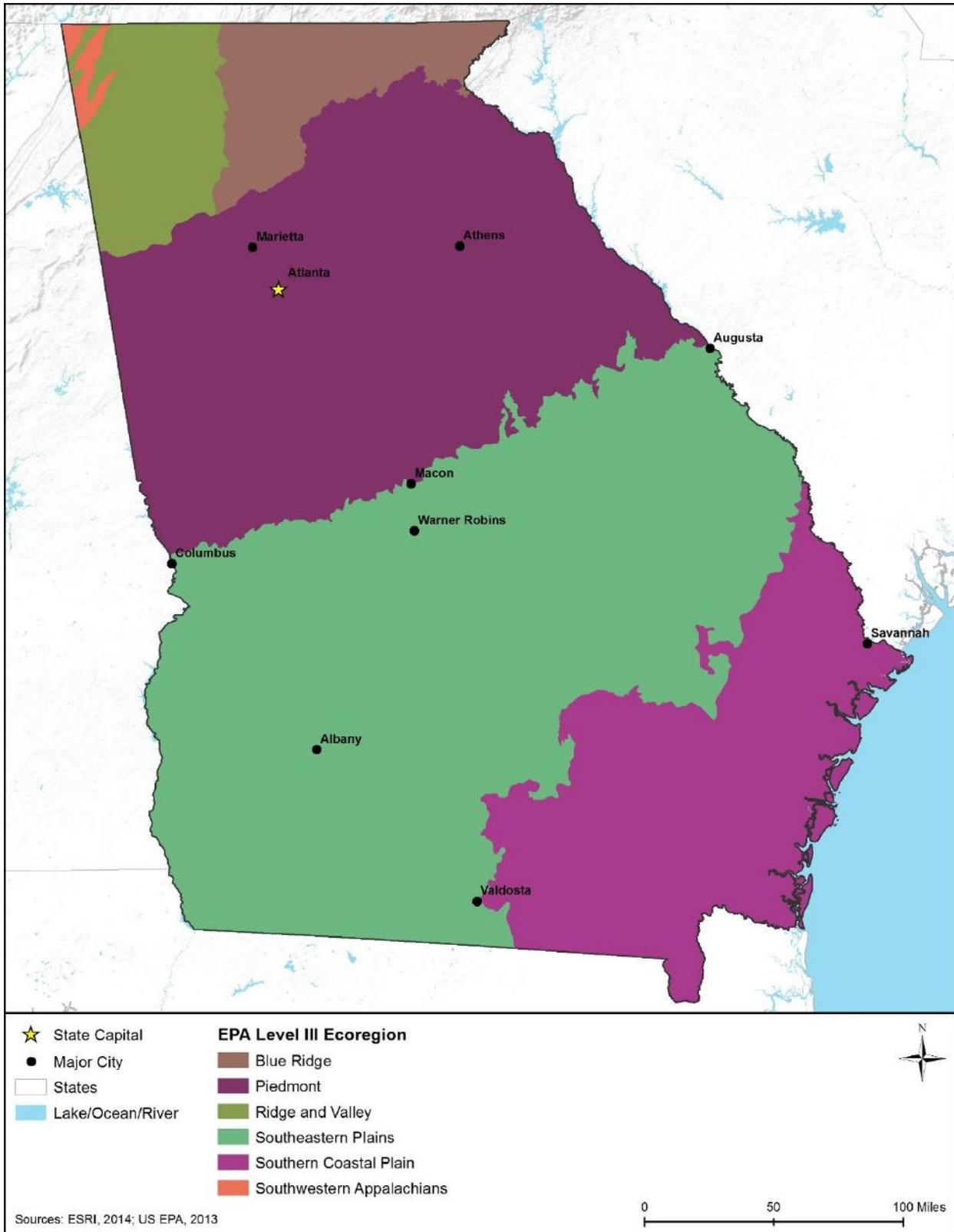
Ecoregion boundaries often coincide with physiographic regions of a state. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North 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 Georgia at USEPA Level III. (USEPA, 2016b)

As shown in Figure 6.1.6-1, the USEPA divides Georgia into six Level III ecoregions. The six ecoregions support a variety of different plant communities, all predicated on their general location within the state. Two of the ecoregions are located in the southern half of the state, in the Atlantic Plain physiographic region, where elevations are lower and communities range from forests of pine to coastal marshes. The remaining four ecoregions are north of the Fall Line and are generally at higher elevations and include spruce-fir forests and heath balds<sup>83</sup> (GADNR, 2001). Table 6.1.6-2 provides a summary of the general abiotic<sup>84</sup> characteristics, vegetative communities, and the typical vegetation found within each of the six Georgia ecoregions.

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<sup>83</sup> Heath bald: a shrubland found at middle to high elevations, treeless, and often on extremely steep and rocky ridges.

<sup>84</sup> 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, 2016c).



**Figure 6.1.6-1: USEPA Level III Ecoregions of Georgia**

**Table 6.1.6-2: USEPA Level III Ecoregions of Georgia**

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
<b>Geographic Region: Southern Plains (South of the Fall Line/Atlantic Plain)</b>				
65	Southeastern Plains	Irregular plains with less relief than Piedmont to the north. Sands, silts, and clays in the Southeastern Plains contrast with metamorphic and igneous rocks found in the Piedmont.	Mixed forest and oak-hickory-pine	<b>Hardwood Trees</b> – turkey oak ( <i>Quercus laevis</i> ), red oak ( <i>Quercus rubra</i> ), water oak ( <i>Quercus nigra</i> ), hickory ( <i>Carya</i> spp.) <b>Conifer Trees</b> – longleaf pine ( <i>Pinus palustris</i> ), loblolly pine ( <i>Pinus taeda</i> ), shortleaf pine ( <i>Pinus echinata</i> )
75	Southern Coastal Plain	This Ecoregion is composed primarily of flat plains, but also contains barrier islands, lagoons, marshes, and swamps. Soils are wetter and elevation is lower than in the Southeastern Plains to the north.	A variety of forest communities, including pine flatwoods	<b>Hardwood Trees</b> – pond cypress ( <i>Taxodium ascendens</i> ), beech ( <i>Fagus</i> sp.), sweetgum ( <i>Liquidambar styraciflua</i> ), southern magnolia ( <i>Magnolia grandiflora</i> ), oak ( <i>Quercus</i> spp.) <b>Conifer Trees</b> – longleaf pine, pond pine ( <i>Pinus serotina</i> ), slash pine ( <i>Pinus elliottii</i> ), loblolly pine
<b>Geographic Region: Northern Highlands (North of the Fall Line/Appalachian Highlands)</b>				
45	Piedmont	Referred to as the non-mountainous area of the Appalachian Highlands and made up of plains and hills. Finer soil than coastal areas.	Pine and hardwood forests	<b>Hardwood Trees</b> – oak, hickory <b>Conifer Trees</b> – pine ( <i>Pinus</i> spp.) species including loblolly pine and shortleaf pine
66	Blue Ridge	Composed of mountainous areas, narrow ridges, and hilly plateaus of igneous, metamorphic, and sedimentary rock.	Oak forests, northern hardwoods, spruce-fir forests, heath balds	<b>Hardwood Trees</b> – oak, hemlock ( <i>Tsuga</i> spp.) <b>Conifer Trees</b> – pine, spruce ( <i>Picea</i> spp.), fir ( <i>Abies</i> spp.)
67	Ridge and Valley	Low lying area of parallel ridges and valleys between higher elevation Blue Ridge and Southwestern Appalachian ecoregions.	Pine at higher elevations transitioning to hardwoods along streams	<b>Hardwood Trees</b> – oak, hickory <b>Conifer Trees</b> – longleaf pine
68	Southwestern Appalachians	Low mountains with topography ranging from smoother areas in the east to rough, more extreme relief to the west.	Mixed mesophytic forest and forests of mixed oaks-hickory and oak-pine	<b>Hardwood Trees</b> – oak, sugar maple ( <i>Acer saccharum</i> ), white ash ( <i>Fraxinus americana</i> ) <b>Conifer Trees</b> – shortleaf pine, Virginia pine ( <i>Pinus virginiana</i> ) <b>Shrubs</b> – redbud ( <i>Cercis canadensis</i> ), flowering dogwood ( <i>Cornus florida</i> )

Source: (USEPA, 2016b) (Fenneman, 1916) (CEC, 2011)

## Communities of Concern

Georgia 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<sup>85</sup> that could result from implementation of an action.

The Nongame Conservation Section of the GADNR maintains a statewide inventory that includes lists of all types of natural communities known to occur, or that have historically occurred, in the state (GADNR, 2015d). 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 GADNR ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Georgia. Communities ranked as an S1 by the GADNR 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 (GADNR, 2015d) (NatureServe, 2015).

Four vegetative communities are ranked as S1 communities<sup>86</sup> in Georgia. These communities represent the rarest terrestrial habitat in the state and are found in the two southernmost ecoregions (Southern Plains and Southern Coastal Plain ecoregions) and the Ridge and Valley ecoregion in the far northwestern corner of the state (GADNR, 2015e). Georgia Appendix A contains a table that provides a description of the communities of conservation concern in Georgia along with their state rank, distribution, and the associated USEPA Level III ecoregions.

## Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but such impacts often result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species.

Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (GPO, 2015a). The U.S. government has designated certain plant species as noxious weeds in

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<sup>85</sup> Community: “In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest” (USEPA, 2015d).

<sup>86</sup> S1 – “Critically Imperiled – Critically imperiled in Georgia because of extreme rarity or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state” (GADNR, 2015d).

accordance with the Plant Protection Act of 2000 (7 United States Code [U.S.C.] 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b).

The state of Georgia does not maintain a list of regulated noxious weeds. The Georgia Invasive Species Task Force (Task Force) includes the Georgia Department of Agriculture, Georgia Forestry Commission, GADNR, and the University of Georgia (UGA). These agencies have long-standing relationships with other state and federal agencies, and the Task Force agencies have legislative authority for action regarding invasive species detection and response, including an Incident Command System that identifies the role of each agency (GADNR, 2009a). The Georgia Exotic Pest Plant Council (GAEPPC, 2015), with members from state agencies, private industry, and education; publishes an invasive plant<sup>87</sup> list, which does not have any regulatory authority, “to identify and categorize plants that pose threats to natural areas in Georgia.” The list includes both aquatic and terrestrial plants that are categorized as described below (count of species included parenthetically) (GAEPPC, 2015):

- Category 1 (20 species): “Exotic plant that is a serious problem in Georgia natural areas by extensively invading native plant communities and displacing native species.”
- Category 1 Alert (8 species): “Exotic plant that is a not yet a serious problem in Georgia natural areas, but that has significant potential to become a serious problem.”
- Category 2 (21 species): “Exotic plant that is a moderate problem in Georgia natural areas through invading native plant communities and displacing native species, but to a lesser degree than category 1 species.”
- Category 3 (50 species): “Exotic plant that is a minor problem in Georgia natural areas, or is not yet known to be a problem in Georgia but is known to be a problem in adjacent states.”
- Category 4 (45 species): “Exotic plant that is naturalized in Georgia but generally does not pose a problem in Georgia natural areas or a potentially invasive plant in need of additional information to determine its true status.”

#### **6.1.6.4. Terrestrial Wildlife**

This section discusses the terrestrial wildlife species in Georgia, divided among mammals,<sup>88</sup> birds,<sup>89</sup> reptiles<sup>90</sup> and amphibians,<sup>91</sup> and invertebrates.<sup>92</sup> Terrestrial wildlife consist of those

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<sup>87</sup> Invasive Plant: “Invasive species is defined as any species, including its seeds, spores or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause environmental harm. Political boundaries are not used when determining a species nativity. Instead a species is defined as being exotic when it is not native to a particular ecosystem, making it possible to have a species that is native to parts of Georgia, but considered invasive in others” (GAEPPC, 2015).

<sup>88</sup> Mammals: “Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs” (USEPA, 2015d).

<sup>89</sup> Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves” (USEPA, 2015d).

<sup>90</sup> Reptile: “Cold-blooded, air-breathing vertebrates belonging to the class Reptilia, usually covered with external scales or bony plates” (USEPA, 2015d).

<sup>91</sup> Amphibian: “A cold-blooded vertebrate that lives in water and on land. Amphibians’ aquatic, gill-breathing larval stage is typically followed by a terrestrial, lung-breathing adult stage” (USEPA, 2015d).

<sup>92</sup> Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015d).

species, and their habitats, that live predominantly on land. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy.

## Mammals

Georgia is home to over 90 species of mammals; rodents and bats comprise about half of these mammals. Several mammal species in Georgia are common and widespread throughout the state, including the Virginia opossum (*Didelphis virginiana*). However, there are also a number of species with more restricted ranges. There are approximately 48 species that inhabit the mainland of Georgia's Atlantic coast, but only half of these species also occupy the adjacent barrier islands. Georgia caves, located farther north, are important for many bat species, including the endemic<sup>93</sup> gray bat (*Myotis grisescens*) (NGE, 2013a).

Larger mammal species that are regulated as game in Georgia include deer and bear (e.g., White-tailed deer (*Odocoileus virginianus*) and Black bear (*Ursus americanus*)) (GAWRD, 2016). Small game includes squirrel (*Sciuridae*), fox (*Vulpes*), bobcat (*Lynx rufus*), opossum (*Didelphis virginiana*), rabbit (*Leporidae*), and raccoon (*Procyon lotor*) (GADNR, 2015f) (GAWRD, 2016). Two endangered and one threatened terrestrial mammals are also located in Georgia. Section 6.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

## Birds

The number of native bird species documented in Georgia varies according to the timing of the data collection effort, changes in bird taxonomy,<sup>94</sup> and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities found in Georgia support a large variety of bird species.

Georgia provides habitat for nearly 350 species of birds, including migratory and resident species. In southern Georgia, between 90 and 110 species are known to nest. Notable features in southern Georgia include the large wading bird colonies with more than 30,000 nests and the Okefenokee Swamp, which provides habitat for approximately 232 species, including 64 nesting species. Approximately 130 birds are known to nest in north Georgia where the Blue Ridge Mountain area is an important area for breeding-bird diversity because it provides habitat for species that nest only at high elevations (NGE, 2015a).

Georgia is located within the Atlantic Flyway, which generally follows the Atlantic Coast and Appalachian Mountains. The Atlantic Flyway extends from the Arctic islands and coast of Greenland south to eastern Mexico and the Caribbean Sea. Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. The Migratory

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<sup>93</sup> Endemic: "A species that is restricted in its distribution to a particular locality or region" (USEPA, 2015d).

<sup>94</sup> Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015d).

Bird Treaty Act (MBTA) makes it “illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations” (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes along the state’s Atlantic Coast (eBird, 2015). Golden eagles are found in a variety of habitat types; however, they are very rare in Georgia (GADNR, 2016a). Consequently, golden eagles observed within the state are generally transients (GADNR, 2015g).

Forty-four Important Bird Areas (IBAs) have also been identified in Georgia. 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 key habitat for native bird populations.<sup>95</sup> 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 Audubon Society, a total of 44 IBAs have been identified in Georgia, including (9 global<sup>96</sup> IBAs and 35 state<sup>97</sup> IBAs) (National Audubon Society, 2015a). These IBAs are located throughout the state, although the largest concentration are located along Georgia’s Atlantic Coast. Figure 6.1.6-2 depicts the IBAs in Georgia. These coastal IBAs include the Cumberland Island IBA, which is a United Nations-sanctioned International Biosphere Reserve. Over 335 bird species have been recorded migrating through the Cumberland Island IBA, which also supports many resident species (National Audubon Society, 2015b). The Cumberland Island IBA and the nearby St. Catherine’s Island IBA are some of the most important feeding and overwintering areas on the Atlantic Coast (National Audubon Society, 2015c).

Three threatened and one endangered bird species are located in Georgia; Section 6.1.6.6, Threatened and Endangered Species and Species of Special Concern, identifies these protected species.

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<sup>95</sup> Population: “Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding” (USEPA, 2015d).

<sup>96</sup> Global IBAs include sites that meet at least one Global criteria (i.e., sites with significant numbers of globally threatened species, sites supporting 1 percent or greater population of a waterbird simultaneously).

<sup>97</sup> State IBAs include areas important to species only according to state-specific criteria (e.g., state-listed species).

## Reptiles and Amphibians

There are over 150 species of reptiles and amphibians in Georgia: 80 species of amphibians that include 30 frog species, as well as 41 species of snakes, 27 species of turtles, six skink species (NGE, 2015b). The approximately 80 species of amphibians in Georgia are found throughout the state and include several very large organisms (> 3 feet in length): giant salamanders in the southern half of the state and the hellbender (*Cryptobranchus alleganiensis*) in colder, mountain streams. The small Striped newt (*Notophthalmus perstriatus*) (2.5-4 inches) is also found in Georgia (GADNR, 2009b). The smallest frog in the country, the little grass frog (*Pseudacris ocularis*), is also found in southern Georgia. Among the reptile species of Georgia, the snake species include five venomous snakes from the pit viper family, such as the Timber rattlesnake (*Crotalus horridus*) and Eastern diamondback rattlesnake (*Crotalus adamanteus*), and one species from the cobra family (the coral snake) (USFS, 2016). The American alligator (*Alligator mississippiensis*) is also native to Georgia and is common along the coast (NGE, 2015b). GADNR regulates a yearly alligator hunt to manage the population (GADNR, 2015h).

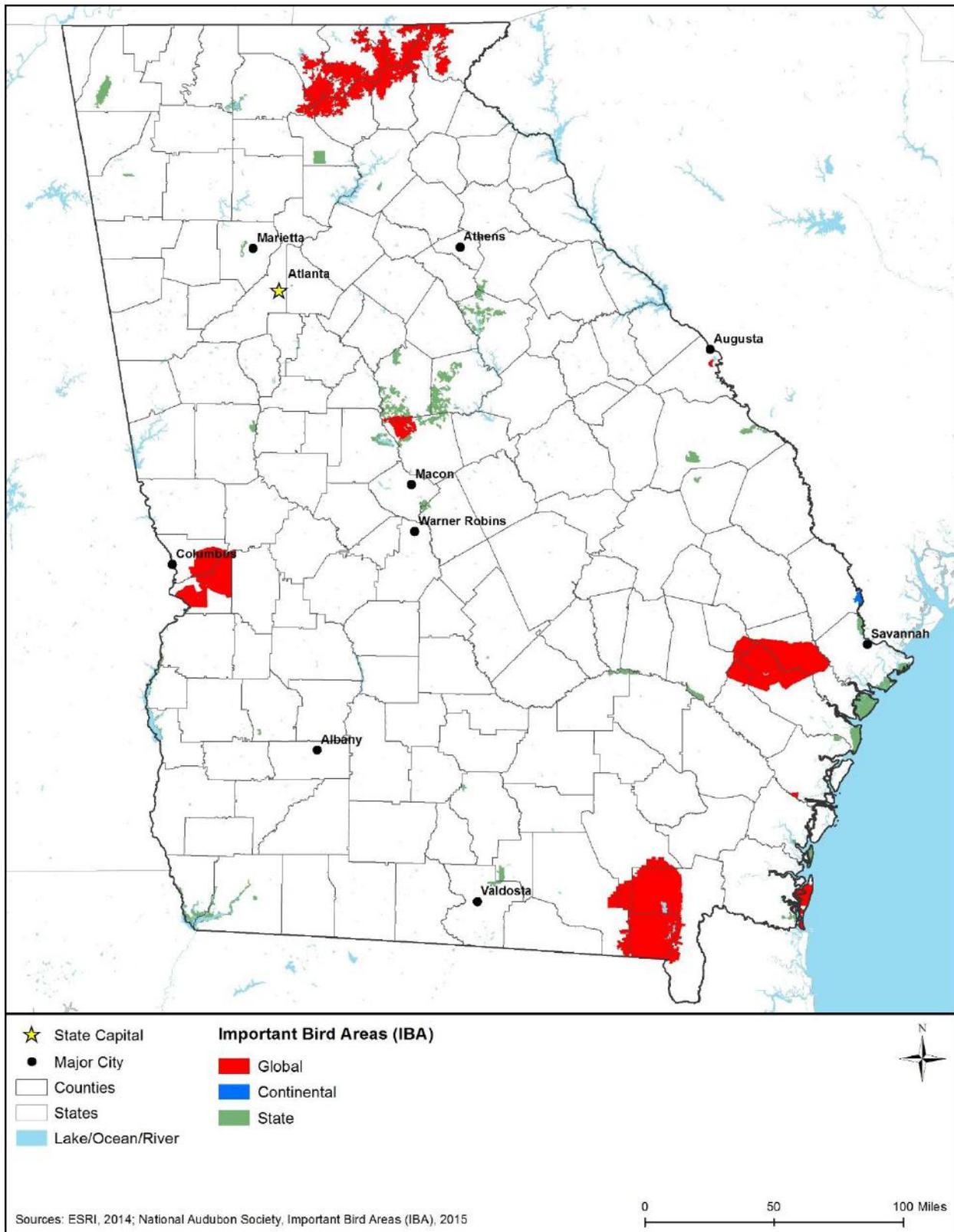
Five threatened and endangered reptiles and amphibians are located in Georgia; Section 6.1.6.6, Threatened and Endangered Species and Species of Special Concern, identifies these protected species.

## Invertebrates

Georgia is home to a variety of invertebrate species, including 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.<sup>98</sup> 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). In the southeastern U.S., the important insect pollinators include honey bees, bumble bees, soil-nesting bees, and mason bees (University of Georgia, 1998).

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<sup>98</sup> Pollinators: “Animals or insects that transfer pollen from plant to plant” (USEPA, 2015d).



**Figure 6.1.6-2: Important Bird Areas in Georgia**

## **Invasive Wildlife Species**

In Georgia, exotic wildlife species are regulated and GADNR must be consulted prior to acquiring any species that is not normally domesticated in Georgia. Examples of these exotic species that have the potential to also be invasive include the feral hog (*Sus scrofa*). According to GADNR Georgia Invasive Species Strategy,<sup>99</sup> examples of these exotic species that also have the potential to be invasive include monk parakeet (*Myiopsitta monachus*), sparrows (species of *Passer* except English sparrow); blackbirds and grackles (all species of *Molothrus*, *Quiscalus*, *Agelaius*); starlings (except European starling [*Sturnus vulgaris*]); and all species of crocodiles, cobras, vipers, Gila monsters, and beaded lizards (GADNR, 2009a). Invasive wildlife species are important to consider when proposing a project since project activities may result in conditions that favor the growth and spread of invasive wildlife populations. These situations may result from directly altering the landscape or habitat to a condition that is more favorable for an invasive species, or by altering the landscape or habitat to a condition that is less favorable for a native species.

### **6.1.6.5. Fisheries and Aquatic Habitat**

This section discusses the aquatic wildlife species in Georgia, including marine mammals and reptiles, saltwater and freshwater fish, and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. Some distinctive features of the Georgia landscape with regard to aquatic wildlife are the fresh, cold trout streams of north Georgia, large river systems of the plains, and estuarine and saltwater marshes of the coast. These variable conditions provide habitat for a diverse array of aquatic organisms. Both essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act and critical habitat for threatened and endangered aquatic species, as defined by the ESA, exist within the aquatic communities of Georgia, and are discussed in the following sections.

### **Essential Fish Habitat**

The Magnuson-Stevens Fishery Conservation and Management Act identifies and protects those fish habitats that are necessary for spawning, breeding, feeding, or growth to maturity. These habitats are termed “Essential Fish Habitat” or EFH. NOAA provides an online mapping application<sup>100</sup> and website<sup>101</sup> to provide the public a means to obtain illustrative representations of EFH. This tool is used to identify the existing conditions for a project location to identify sensitive resources.<sup>102</sup> Georgia Appendix A contains tables with a summary of EFH for both Mid-Atlantic and South Atlantic species of the Georgia coast.

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<sup>99</sup> Invasive species: “refers to nonnative species that have been introduced, either intentionally or accidentally, into areas outside their natural ranges and that cause economic or environmental harm or impacts to human health.”

<sup>100</sup> <http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html>.

<sup>101</sup> <http://www.greateratlantic.fisheries.noaa.gov/hcd/list.htm>.

<sup>102</sup> NOAA’s Essential Fish Habitat Mapper v 3.0 was used to identify “EFH areas of particular concern” and “EFH areas protected from fishing”. As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit <http://www.habitat.noaa.gov/protection/efh/habitatmapper.html>. 2) Select “EFH Mapper” under Useful Links. 3) After closing the opening tutorial, select the “Region” of interest from the drop-down menu. 4) Select the species under “Essential Fish Habitat” to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).

Under the Magnuson-Stevens Act, the National Marine Fisheries Service also considers “a second, more limited habitat designation for each species in addition to EFH. Habitat Areas of Particular Concern (HAPC) are described as subsets of EFH which are rare, particularly susceptible to human-induced degradation<sup>103</sup>, especially ecologically important, or located in an environmentally stressed area. In general, HAPCs include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish...HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations” (NOAA, 2010). Table 6.1.6-3 presents a summary of HAPC along or near the Georgia coast. Table A-2 in Georgia Appendix A discusses EFH in more detail.

**Table 6.1.6-3: Habitat Areas of Particular Concern for Georgia**

Species	Description of EFH – HAPC
Tilefish	Offshore
Coastal Migratory Pelagics	Offshore to north near SC
Corals	Nearshore to south in Florida, offshore (Gray’s Reef National Marine Sanctuary)
Dolphin/Wahoo	Offshore to north near SC
Snapper/Grouper	Inshore along estuaries, nearshore and offshore.
Shrimp	Inshore along estuaries
Spiny Lobster	None

Source: (GSAA, 2016)

### Marine Mammals

Manatees (*Sirenia*) and dolphins (*Delphinidae*) are found in the waters surrounding Georgia’s barrier islands; two species of whale: the humpback whale (*Megaptera novaeangliae*) and North Atlantic right whale (*Eubalaena glacialis*) inhabit the waters off Georgia’s Atlantic coast (Castleberry 2013). The waters of coastal Georgia and Florida are the only known calving grounds for the North Atlantic right whale, which is the most endangered whale worldwide. Right whales migrate to their calving grounds in late fall where they remain from December to April. (NGE, 2013b).

Georgia’s threatened and endangered aquatic mammals are discussed further in Section 6.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

<sup>103</sup> Degradation: “The reduction of the capacity of the environment to meet social and ecological objectives, and needs. Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards” (USEPA, 2015d).

## Marine Reptiles

Five of the world's seven species of sea turtles are found in Georgia's coastal waters, and two of the five species are known to nest on Georgia beaches. (GADNR, 2015i) (NGE, 2013c)

- The loggerhead turtle (*Caretta caretta*) is the most common sea turtle found in Georgia and the only species that nests regularly in the state;
- The leatherback turtle (*Dermochelys coriacea*) may occasionally nest in Georgia;
- Green turtles (*Chelonia mydas*) are only occasionally found in Georgia's waters; and
- The Hawksbill (*Eretmochelys imbricata*) and Kemp's ridley (*Lepidochelys kempii*) sea turtles are found more rarely in Georgia's waters and are not known to nest on Georgia's coast.

The five sea turtle species found in Georgia are state and federally protected; protected sea turtle species are discussed in Section 6.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

## Saltwater Fish

Although the Atlantic coast of Georgia is relatively small (approximately 100 miles in length (NGE, 2015c), there are a variety of estuarine and marine habitats available for fish. Some of the more common nearshore marine species in Georgia include: striped burrfish (*Chilomycterus schoepfi*), striped mullet (*Mugil cephalus*), Atlantic menhaden (*Brevoortia tyrannus*), blue runner (*Caranx crysos*), bluefish (*Pomatomus saltatrix*), crevalle jack (*Caranx hippos*), catfish (gafftopsail [*Bagre marinus*], hardhead [*Arius felis*]), inshore lizardfish (*Synodus foetens*), ladyfish (*Elops* spp.), mummichog (*Fundulus heteroclitus*), northern puffer (*Sphoeroides maculatus*), northern searobin (*Prionotus carolinus*), oyster toadfish (*Opsanus tau*), pigfish (*Orthopristis chrysoptera*), pinfish (*Lagodon rhomboids*), and silver perch (*Bairdiella chrysoura*). Georgia's saltwater environments are also home to a number of pelagic fish (for example, barracuda [*Sphyraena* spp.] several species of billfish, and tuna [*Thunnus* spp.] species) and reef fish (such as grouper and snapper). Sharks and rays are also found in Georgia's coastal waters (GADNR, 2015j).

Georgia's popular, regulated sportfish species include the Atlantic croaker (*Micropogonias undulatus*), black drum (*Pogonias cromis*), black seabass (*Centropristis striata*), Florida pompano (*Trachinotus carolinus*), red drum (*Sciaenops ocellatus*), flounder (southern [*Paralichthys lethostigma*] and summer [*Paralichthys dentatus*]), southern kingfish (*Menticirrhus americanus*), spot (*Leiostomus xanthurus*), spotted seatrout (*Cynoscion nebulosus*), tarpon (*Megalops atlanticus*), tripletail (*Lobotes surinamensis*), and weakfish (*Cynoscion regalis*) (GADNR, 2015j).

Several highly migratory fish species are known from Georgia's waters, including the federally endangered Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), a long-lived species that lives in marine waters as an adult and migrates to freshwater to spawn (Schueller & Peterson, 2010). The Atlantic sturgeon is also Georgia's largest fish (GADNR, 2015j).

## Freshwater Fish

Georgia's varied physical geography provides for a wide range of freshwater habitats, with over 4,000 miles of trout streams in northern Georgia and large riverine systems farther south (GADNR, 2015k). These habitats support approximately 265 native species from 27 different families, including five endemic species that are unique to Georgia. The most diverse fish families found in Georgia are (GADNR, 2015l):

- minnows (*Cyprinidae*);
- darters (*Percidae*);
- sunfishes (*Centrarchidae*);
- suckers (*Catostomidae*); and
- catfishes (*Ictaluridae*).

Georgia is also home to at least five endemic freshwater species including two shiners (*Cyprinella* spp.), two darters (*Etheostoma* spp.), and the Chattahoochee sculpin (*Cottus chattahoocheae*) (GADNR, 2015l). Georgia's protected fish species are identified in Section 6.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

## Shellfish and Other Invertebrates

The southeastern U.S. has the most diverse population of freshwater mussels in the world and in this region, Georgia ranks fourth in mussel diversity (NGE, 2013d). Georgia's diverse freshwater mollusk population includes 67 snails and 98 mussels. This is also an extremely imperiled group, with nearly 50 percent of snails and 75 percent of mussels identified as at risk. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), another well-known Georgia freshwater invertebrate is the crayfish. In Georgia estuarine and saltwater environments, crabs, shrimp, and oysters are common. Georgia shrimp are important commercially and, as the most valuable seafood crop in Georgia, constituting more than 80 percent of the total value of seafood caught per year (NGE, 2013e).

Georgia's protected shellfish and other invertebrates are identified in Section 6.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

## Invasive Aquatic Species

As previously discussed, Georgia regulates exotic wildlife species and the GADNR must be contacted regarding any species not normally domesticated in Georgia. Potentially invasive aquatic examples include: piranha; grass (*Ctenopharyngodon idella*), silver (*Hypophthalmichthys molitrix*), and bighead carp (*Hypophthalmichthys nobilis*); air breathing, parasitic, and giant walking catfish (*Clarias batrachus*); snakeheads; freshwater stingray (*Himantura polylepis*) and giant and marine toads (GADNR, 2009a). According to the GADNR, some aquatic invasive species of note include blueback herring (*Alosa aestivalis*), spotted bass (*Micropterus punctulatus*), and flathead catfish (*Pylodictis olivaris*) which have disrupted local fisheries. Zebra mussels (*Dreissena polymorpha*), which have not yet been documented in Georgia (GADNR, 2015m) could also be a serious threat to Georgia's native mussels (GADNR, 2015n). The UGA Marine Extension Service (MAREX) has identified the following species as known

invasive aquatic species: green mussel (*Perna viridis*), charrua mussel (*Mytella charruana*), titan acorn barnacle (*Megabalanus coccopoma*), Australian tubeworm (*Ficopomatus enigmaticus*), green porcelain crab (*Petrolisthes armatus*), red lionfish (*Pterois volitans*), island apple snail (*Pomacea insularum*), Alligatorweed (*Alternanthera philoxeroides*), Water hyacinth (*Eichhornia crassipes*), Hydrilla (*Hydrilla verticillata*), Marsh dewflower (*Murdannia keisak*), and Giant salvinia (*Salvinia molesta*). In addition to causing ecological issues, the invasion of these species can also bring new parasites and/or diseases that could potentially affect human health. (University of Georgia, 2015a).

#### **6.1.6.6. Threatened and Endangered Species**

The USFWS is responsible for administering the ESA (16 U.S.C. § 1531 et seq.) in Georgia. The USFWS has identified 46 federally endangered and 21 federally threatened species known to occur in Georgia (USFWS, 2015c). Of these 69 federally listed species, 23 of them have designated critical habitat<sup>104</sup> (USFWS, 2015d). Five candidate<sup>105</sup> species are identified by USFWS as occurring within the state (USFWS, 2015e). 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, 2014a). The 69 federally listed species include 7 mammals, 5 reptiles, 4 birds, 9 fish, 2 amphibians, 15 invertebrates, 27 plants (USFWS, 2015c), and are discussed in detail under the following sections.

Federal land management agencies maintain lists of species of concern for this 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**

Five endangered and two threatened mammals are federally listed and known to occur in Georgia as summarized in Table 6.1.6-4. These species include three bats and four marine mammals. The three terrestrial species, all bats, occur in the north and northwest portions of the state. Three of the marine mammals are whales that are found off the coast of Georgia, and the fourth marine mammal, the West Indian manatee (*Trichechus manatus*), can be found in the coastal waters and estuaries along Georgia's coast (USFWS, 2015c). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

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<sup>104</sup> 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)).

<sup>105</sup> 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, 2015c).

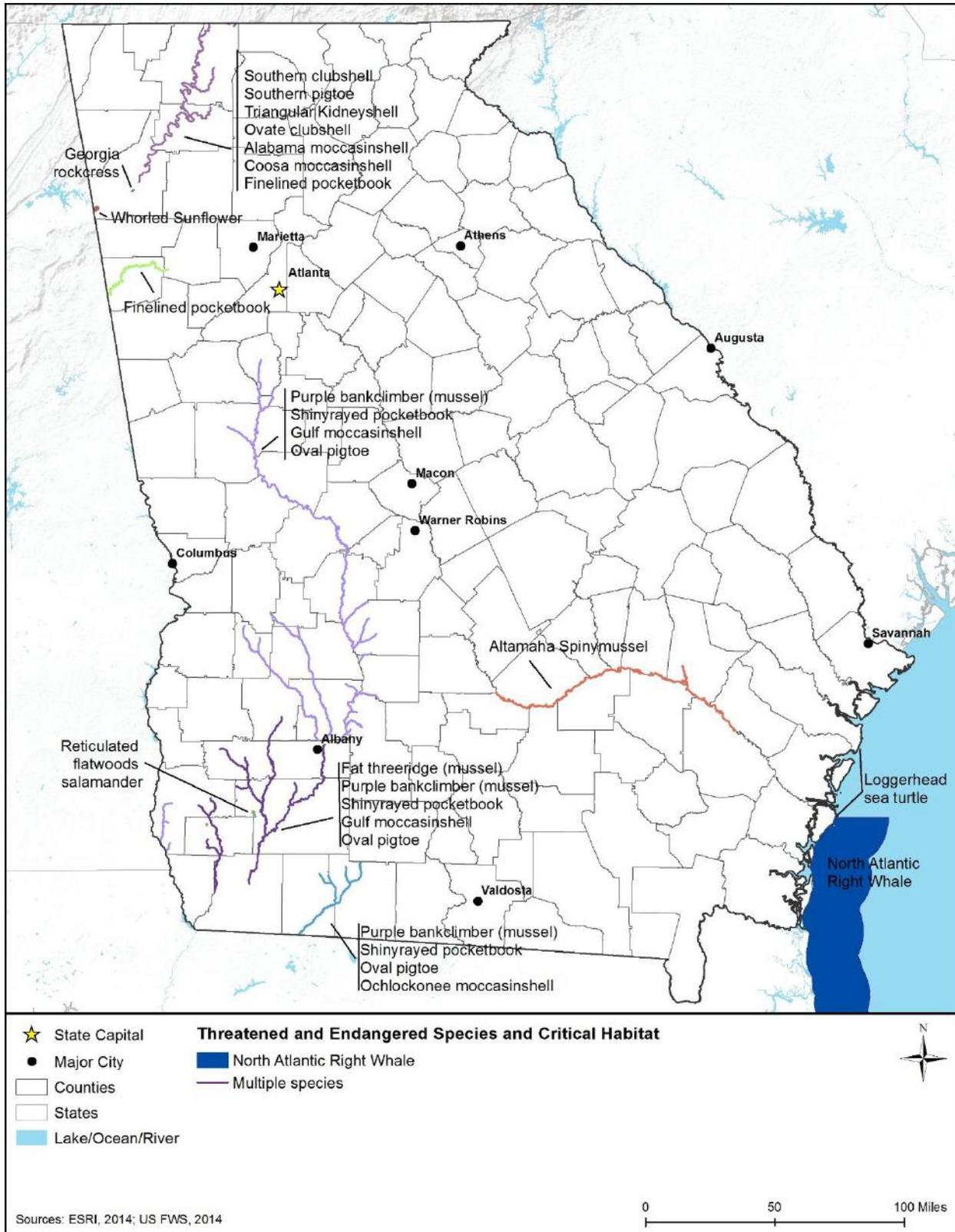


Figure 6.1.6-3: ESA Designated Critical Habitat in Georgia

**Table 6.1.6-4: Federally Listed Mammal Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
<b>Terrestrial Mammals</b>				
Gray Bat	<i>Myotis grisescens</i>	Endangered	No	Caves in limestone karst regions near rivers; found in the northwestern region of the state.
Indiana Bat	<i>Myotis sodalis</i>	Endangered	No	Trees and snags, caves, and abandoned mines; found throughout the western region of the state.
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Threatened	No	Trees and snags, caves, and abandoned mines; found throughout the state.
<b>Marine Mammals</b>				
Finback Whale	<i>Balaenoptera physalus</i>	Endangered	No	Deep offshore water in all major oceans.
Humpback Whale	<i>Megaptera novaeangliae</i>	Endangered	No	Coastal waters during migration.
North Atlantic Right Whale	<i>Eubalaena glacialis</i>	Endangered	Yes, critical habitat designated from the shoreline out 5-15 nautical miles between approximately the mouth of the Altamaha River to Sebastian Inlet, Florida.	Calve in shallow coastal waters from November to March (primarily January to March).
West Indian Manatee	<i>Trichechus manatus</i>	Threatened	No	Coastal waters, estuaries, and warm water outfalls.

Source: (USFWS, 2015c) (USFWS, 2016a)

### Terrestrial Mammals

**Gray Bat.** The gray bat (*Myotis grisescens*) is an insectivorous<sup>106</sup> bat that weighs approximately 7 to 16 grams and it is longer than any other species in the genus *Myotis*. Gray bats have dark gray fur after molting in July or August and then the fur transitions to a chestnut brown. This species was federally listed as endangered in 1976 (41 FR 17736 17740, April 28, 1976). Regionally, this species is known to occur in limited geographic regions of limestone karst within southeastern states from Kansas and Oklahoma east to Virginia and North Carolina (USFWS, 1997a) (USFWS, 2015f). In Georgia, the gray bat is known to occur in 11 counties in the northwest region of the state (USFWS, 2015f).

Gray bats live in caves all year, hibernating in deep vertical caves in the winter and roosting<sup>107</sup> in caves scattered along rivers the rest of the year. Most caves are in limestone karst regions and near rivers where these bats feed on flying aquatic and terrestrial insects. Current threats to this species include human disturbance, habitat loss and degradation from flooding, and

<sup>106</sup> Insectivorous: “An animal that feeds on insects” (USEPA, 2015d).

<sup>107</sup> Roost: “A place where a flying animal, usually a bird or bat, can sleep or rest, usually by perching or hanging” (USFWS, 2015g).

commercialization of caves (e.g., adding gates that alter air flow, humidity, and temperature in caves) (GADNR, 2009c) (USFWS, 1997a).

**Indiana Bat.** The Indiana bat (*Myotis sodalis*) 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. Indiana bats have dull grayish chestnut fur and strongly resembles the more common little brown bat (*Myotis lucifugus*) (GADNR, 2009d) (USFWS, 2015h). The Indiana bat was originally federally listed as “in danger of extinction” under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.). In 2009, only 387,000 Indiana bats were known to exist in its range, less than half of the population of 1967 (USFWS, 2015i). Regionally, this species is currently found in the central portion of the eastern United States, from Vermont west to Wisconsin, Missouri, and Arkansas, and south and east to northwest Florida. In Georgia, the Indiana bat is known to occur in 7 counties in the northwest portion of the state (USFWS, 2015j).

In the fall, the Indiana bats migrate to their hibernation<sup>108</sup> sites in caves and abandoned mines in order to mate and build up fat reserves for hibernation season in the winter. Upon emerging from hibernation, the bats feed near their hibernations sites (within 10 miles) before migrating to their summer habitats, where the females roost (USFWS, 2015h). Some of these summer habitats can be as far as 300 miles away from their hibernation areas (USFWS, 2004). Indiana bats roost in trees during the day and feed at night in a variety of habitats, although 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*) (USFWS, 2012a).

The threats to this species include the disturbance and intentional killing of hibernating and maternity colonies, habitat fragmentation<sup>109</sup> and degradation, use of pesticides or other contaminants, White Nose Syndrome, and commercialization of caves (e.g., adding gates that alter air flow, humidity, and temperature in caves) (USFWS, 2004) (USFWS, 2015i). 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 (*Myotis septentrionalis*) is a medium-sized, brown furred, insectivorous bat. This bat is medium-sized, reaching a length of 3 to 3.7 inches, with long ears relative to other members of the genus *Myotis* (USFWS, 2015l). 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). Its range

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<sup>108</sup> Hibernation: “The act of passing the winter in a dormant state in which the metabolism is slowed to a tiny fraction of normal” (USFWS, 2015k).

<sup>109</sup> Fragmentation: “The breaking up of large and continuous ecosystems, communities, and habitats into smaller areas that are surrounded by altered or disturbed land or aquatic substrate” (USEPA, 2015d).

includes most of the eastern and north central United States (USFWS, 2015m). In Georgia, the northern long-eared bat is known to occur in 34 counties in the northern portion of the state (USFWS, 2015m).

Northern long-eared bats hibernate during winter in caves and mines that exhibit constant temperatures and high humidity, which do not have air currents. In the summer they roost singly or in colonies beneath bark, or in crevices or cracks of both live and dead trees. Although mating occurs in the fall, fertilization occurs following hibernation. Pregnant females then migrate to summer areas where they roost in small colonies (USFWS, 2015l).

White Nose Syndrome is the leading cause for the decline of this species. The numbers of Northern long-eared bats in hibernacula has decreased by 99 percent in the northeast United States. (USFWS, 2015m). Other threats include hibernacula impacts (e.g., temperature or air flow restrictions), habitat loss or fragmentation, habitat forest management practices that are incompatible with this species' habitat needs, and strikes with wind turbines (USFWS, 2015l).

### **Marine Mammals**

***Finback Whale.*** The finback whale (*Balaenoptera physalus*), also referred to as the fin whale, is the second largest whale in the world, reaching a length from 75 to 85 feet and weighing between 80,000 and 160,000 pounds (NOAA, 2013). The species was first federally listed as endangered under early endangered species legislation in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015n). Finback whales are found in all of the world's oceans, are highly nomadic, move in social groups of two to seven individuals, and prefer high latitudes and cold currents where food concentrations are high (NOAA, 2013).

Finback whales primarily feed on krill, small fish, and squid, moving through the water at a fast speed averaging 15 miles per hour with bursts of speed reaching 35 miles per hour. In the North Atlantic Ocean, fin whales are often seen in large feeding groups that include humpback whales, minke whales, and Atlantic white-sided dolphins. In the late summer, finback whales migrate to equatorial waters where they spend the winter fasting and living off of their fat reserves. After an 11-12 month gestation period, birthing and nursing occurs (NECWA, 2007) (NOAA, 2013).

The finback whale population had declined as a result of whaling. Commercial whaling ended in the Northern Pacific Ocean in 1976, the Southern Ocean by 1977, and Northern Atlantic Ocean by 1987, however, finback whales are still hunted in Greenland. Additional current threats to this species include vessel collisions, entanglement in fishing gear, reduced food supply, habitat degradation, noise, and vibration disturbance (NOAA, 2013).

***Humpback Whale.*** The humpback whale (*Megaptera novaeangliae*) reaches 30 to 60 feet in length and is distinguished from other whales by its robust, thick, and chunky body shape and very long (up to 15 feet) white flippers (GADNR, 2009e) (NOAA, 2015c). The humpback whale was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015o). Humpback whales are found in all of the world's oceans. In the North Atlantic Ocean, there are feeding populations found in the Gulf of Maine, the Gulf of St. Lawrence, Newfoundland, and western

Greenland during the spring, summer, and fall as they feed and build up fat reserve to live off all winter. These populations all combine to migrate to their winter breeding and calving grounds in tropical and subtropical waters in the West Indies. Humpbacks travel near the water surface during migrations, and prefer shallow waters during feeding and calving (NOAA, 2015c). The species has been sighted off the Georgia coast (GADNR, 2009e).

While humpback whales are federally listed as an endangered species with an estimated 10,400 individuals in the western North Atlantic, they have shown signs of increasing population (NOAA, 2015c). Current threats to this species include entanglement in fishing gear, ship strikes,<sup>110</sup> harassment from whale watching, habitat degradation, and harvesting for scientific research (NOAA, 2016).

**North Atlantic Right Whale.** The North Atlantic right whale (*Eubalaena glacialis*) is a large baleen whale averaging 50 feet in length and is distinguished from other whale by its stocky body, no dorsal fin, and large head (GADNR, 2009f) (NOAA, 2015d). The Northern Atlantic right whale was originally listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.). In 2008 the NMFS listed the North Atlantic right whale and North Pacific right whale (*Eubalaena japonica*) as two separate endangered species. The North Atlantic right whale is a critically endangered whale with only 450 individuals remaining. They are found in all of the world's oceans and occur primarily in coastal or shelf waters (NOAA, 2015d).

For the majority of the year, North Atlantic right whales are most often found off the coast of New England, moving northward to Canada during the latter part of the summer (NOAA, 2015e). Feeding generally occurs from spring through fall, and their prey consists mainly of zooplankton. During winter, they move southward to the coastal waters between Georgia and Florida to breed and calve. Calving occurs from December through March and vessel traffic speeds are restricted during this time to minimize collisions. Vessels greater than 65 feet must travel at 10 knots or less (NOAA, 2015d). "Right whales are usually sighted 8-40 km (5-25 miles) off the Georgia coast from December through March" (GADNR, 2009f).

Two critical habitat areas have been identified for the North Atlantic right whale, one in the northeast U.S. and one in the southeast U.S. In the northeast U.S., these critical habitats are located in Cape Cod Bay and the Great South Channel offshore of Cape Cod. In the southeast U.S., critical habitat is located as a linear strip from southern Georgia to the approximate midpoint along the east coast of Florida. In Georgia, the designated critical habitat extends from the coastal waters of Little St. Simons Island, Georgia, south to the Florida state line, where the critical habitat continues into Florida (GADNR, 2009f). Current threats to this species include vessel collisions, entanglement in fishing gear, habitat degradation, environmental contaminants, climate change, disturbance from whale watching activities, noise, and vibrations (NOAA, 2015d).

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<sup>110</sup> Ship strikes: Collisions between whales and vessels (IWC, 2016).

**West Indian Manatee.** The West Indian Manatee (*Trichechus manatus*) averages 9 feet in length and weighs about 1,000 pounds (USFWS, 2015p). The manatee was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.). The manatee was downlisted to threatened on March 16, 2017 (USFWS, 2017b). The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA). The manatee has a large, seal-shaped body with flippers and a large tail, and is typically gray in color (USFWS, 2015p). Manatees found in mainland U.S. waters are recognized as a separate subspecies known as the Florida manatee (*Trichechus manatus latirostris*) (USFWS, 2001a).



West Indian Manatee

Photo credit: Gaylen Rathburn (USFWS)

West Indian manatees are found in tropical and subtropical coastal and river waters. The Florida manatee (*Trichechus manatus latirostris*) is found along the southeast U.S. coast, while the Antillean subspecies (*Trichechus manatus manatus*) is typically encountered along the Caribbean coast of Central and South America, and locally throughout the West Indies (USFWS, 2001a). “In Georgia, manatees can be found in any tidal waters from March through October. Habitats in Georgia include nearshore ocean waters, tidal creeks, estuaries, and the lower reaches of the St. Mary’s, Satilla, Altamaha, Ogeechee, and Savannah Rivers. During winter, manatees are attracted to warm water refuges in Florida” (GADNR, 2009g). “Shallow grass beds with ready access to deep channels are preferred feeding areas in coastal and riverine habitats. Manatees often use secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, cavorting, mating, and calving” (USFWS, 2001a).

Threats to West Indian manatees include death or serious injury from vessel strikes, habitat loss or fragmentation leading to decreased availability of warm-water refuges (USFWS, 2001a). “Approximately 30 percent of manatee mortalities documented in Georgia since 1989 were due to watercraft collisions. Some manatees are able to survive boat strikes, as evidenced by propeller scars which are found on survivors’ backs...Other human-related threats include mortality from tide gates and dredges, habitat destruction, and entanglement in fishing gear” (GADNR, 2009g).

## Reptiles

Three endangered and two threatened reptile species are federally listed and known to occur in the state of Georgia as summarized in Table 6.1.6-5. All four sea turtles, hawksbill sea turtle (*Eretmochelys imbricate*), Kemp’s ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), and loggerhead sea turtle (*Caretta caretta*), are found along the coast of Georgia. One terrestrial reptile, the endangered Eastern indigo snake (*Drymarchon corais couperi*), is found in the coastal plain of Georgia. (USFWS, 2015c) The Eastern gopher tortoise (*Gopherus polyphemus*) has been identified as a candidate species in Georgia (USFWS, 2014b).

Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

**Table 6.1.6-5: Federally Listed Reptile Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
<b>Terrestrial Reptiles</b>				
Eastern Indigo Snake	<i>Drymarchon corais couperi</i>	Threatened	No	During winter, den in xeric sandridge habitat preferred by gopher tortoises; during warm months, forage in creek bottoms, upland forests, and agricultural fields.
<b>Marine Reptiles</b>				
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation; migrates through Georgia’s coastal waters.
Kemp’s Ridley Sea Turtle	<i>Lepidochelys kempii</i>	Endangered	No	Muddy or sandy bottoms where prey items can be found, in waters rarely greater than 160 feet deep.
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered	No	Coastal waters and the open sea environment; rarely nests in Georgia.
Loggerhead Sea Turtle	<i>Caretta caretta</i>	Threatened	Yes, critical habitat has been designated along Georgia’s barrier islands.	Open sea environment and inshore area such as salt marshes, creeks, bays, and lagoons; nests on Georgia’s barrier island beaches.

Source: (USFWS, 2015c) (USFWS, 2016a)

### Terrestrial Reptiles

**Eastern Indigo Snake.** “Adults are large and thick bodied. The body is glossy black and in sunlight has iridescent blue highlights. The chin and throat is reddish or white, and the color may extend down the body. The belly is cloudy orange and blue-gray. The scales on its back are smooth, but some individuals may possess some scales that are partially keeled. There are 17 dorsal scale rows at midbody. The pupil is round. Juveniles are black-bodied with narrow whitish blue bands” (USFWS, 2015q). The species was listed as threatened in 1978 (43 FR 4026-4029, January 31, 1978). In the U.S., its range includes the coastal plain areas of Alabama, Florida, and Georgia. In Georgia, the eastern indigo snake (*Drymarchon corais couperi*) is known to occur in 26 counties in the southern portion of the state (USFWS, 2015q).



Eastern Indigo Snake Photo credit: USFWS

Preferred habitat of the indigo snake includes high pineland, flatwoods, dry glades, tropical hammocks, and muckland fields in Florida, and xeric sandridge habitats, such as longleaf pine-scrub oak associations with frequent fire regimes in Georgia. Eastern indigo snakes are

commonly associated with gopher tortoise burrows, which they use as refuges and overwintering sites (USFWS, 1982). “Breeding occurs from November until April, and females typically lay 5-10 eggs during May or June; these are often placed in the moist sand of tortoise burrows” (GADNR, 2009h). Major threats to the eastern indigo snake include fire suppression, habitat conversion to agriculture or pine plantation, and human predation for the pet trade (USFWS, 1982).

## Marine Reptiles

**Hawksbill Sea Turtle.** The hawksbill sea turtle (*Eretmochelys imbricata*) is one of the smaller sea turtles. It was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970). The hawksbill sea turtle has overlapping plates that are thicker than those of other sea turtles. This protects them from being battered against sharp coral and rocks during storm events. Adults range in size from 30 to 36 inches and weigh up to 300 pounds. Its upper shell is dark brown with faint yellow streaks and a yellow under shell. The hawksbill is found throughout all of the oceans of the world (NOAA, 2014b) (USFWS, 2015r). Even though in the Atlantic they range from the East Coast of the United States to northern Brazil, they are more infrequently found offshore of Mid-Atlantic and New England states (NOAA, 2015f). Hawksbills are transient through Georgia waters and are not known to nest in Georgia (GADNR, 2011a). No critical habitat has been designated in Georgia (USFWS, 2015s).

This species prefers warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. As an omnivore, the hawksbill sea turtles feed primarily on sponges, algae, and invertebrates. Nesting for these turtles occurs on remote beaches in the Gulf of Mexico and the Caribbean Sea in two to three year cycles, where females will lay between 140 to 200 eggs (USFWS, 2015r).

Current threats to the hawksbill sea turtle include accidental capture in fishing lines, vessel strikes, contaminants, oil spills, disease, habitat loss or destruction in coral reef communities. Outside of the United States, an additional threat to the species is the harvest of their meat and eggs (NOAA, 2014b).

**Kemp’s Ridley Sea Turtle.** The Kemp’s ridley sea turtle (*Lepidochelys kempii*) is considered the smallest sea turtle species and the most endangered. These sea turtles can grow to more than 2 feet long and weigh up to 100 pounds (NOAA, 2015g) (USFWS, 2015t). The Kemp’s ridley sea turtle was first federally listed in 1970 (35 FR 18319 18322, December 2, 1970) under the Endangered Species Conservation Act and incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015u). Their range includes the Gulf of Mexico and the U.S. Atlantic seaboard, from New England to Florida. They prefer nearshore habitats with muddy or sandy bottoms in waters rarely greater than 160 feet deep, where their prey items such as crabs, jellyfish, fish, and mollusks are found (NOAA, 2015g).

Kemp’s ridley sea turtle gather in large groups in Tamaulipas, Mexico where approximately 95 percent of this species’ breeding occurs. Nesting occurs as early as April and into July. Some males migrate yearly between breeding and feeding grounds, whereas other remain near breeding grounds throughout the year. Hatchlings drift with the currents or float with plant material rafts

for approximately two years (NOAA, 2015g). “In Georgia, juvenile Kemp’s ridley sea turtles are common in estuaries during the months of April through October” (GADNR, 2011b).

Historically, the decline of this species was the harvesting of their sea turtle eggs during nesting. Current threats to this species include the direct harvest of adults and eggs, accidental capture in fishing lines, recreational activities on beaches, and pollution (USFWS, 2015r). “Kemp’s ridley turtles in Georgia waters are most likely susceptible to the same hazards as other species including incidental capture and drowning in the shrimp trawl fishery, collision with recreational and commercial boats, fishing line entanglements, and habitat loss” (GADNR, 2011b).

**Leatherback Sea Turtle.** The leatherback sea turtle (*Dermochelys coriacea*) is the deepest-diving and most wide-ranging sea turtle, growing 4 to 8 feet long and weighing 500 to 2000 pounds (USFWS, 2015v). The leatherback sea turtle was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015w). The leatherback sea turtle is capable of tolerating a wide range of water temperatures; hence its wide global distribution, including parts of the Atlantic, Pacific, and Indian Oceans. The occurrence in the United States is rare for the Atlantic population, with the most significant location within the east coast being in southeastern Florida (NOAA, 2015h) (USFWS, 2015v). No critical habitat has been designated in Georgia (USFWS, 2015w).

Leatherback sea turtles are found in ocean waters and nearshore coastal waters. Their main diet includes jellyfish, salps (a transparent barrel-shaped tunicate<sup>111</sup>), and other soft-bodied animals. This species will forage in both coastal waters and the open sea environment (NOAA, 2015h). For reproduction the female leatherback sea turtles nest at 2 to 3 year intervals during the months of March to July. Nest-building occurs during the night. Each turtle will nest up to 11 nest per nesting season (USFWS, 2015v). “Leatherbacks are found along the Georgia coast during annual migrations in the fall and spring. They are also commonly seen in the winter months foraging on sea jellies...Very few nests have been confirmed in Georgia although a consistent pattern of low annual nesting (<10 nests) has emerged since 2000” (GADNR, 2011c). Current major threats to the species include harvesting of turtles and their eggs, hunting, incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015h).

**Loggerhead Sea Turtle.** The loggerhead sea turtle (*Caretta caretta*) can grow to an average length of 3 feet and weight of 250 pounds. This species has a reddish-brown carapace and flippers, with a large head (USFWS, 2015x). The loggerhead sea turtle was initially listed as threatened throughout its range in 1978 (43 FR 32800 32811, July 28, 1978); by 2011, nine different distinct populations were listed. The northwestern Atlantic Ocean population remained listed as threatened (76 FR 58868 58952, September 22, 2011) (USFWS, 2015y).

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<sup>111</sup> Tunicate: “Commonly known as ‘sea squirts.’ The body of an adult tunicate is quite simple, being essentially a sack with two siphons through which water enters and exits. Water is filtered inside the sack-shaped body” (University of California Museum of Paleontology, 2006).

This turtle is known to occur throughout temperate and tropical regions in the Atlantic, Pacific, and Indian Oceans with most nesting areas located in the western Atlantic Ocean. Nesting by the loggerhead sea turtle occurs from Texas to Virginia along the southeastern coast of the United States (USFWS, 2008a). Loggerhead sea turtles nest on coastal sand beaches near the dune line, or in areas with coral reefs; they prefer to feed in rocky places (NOAA, 2014c). “Loggerheads are found throughout the marine and estuarine waters of Georgia during the warm months of spring, summer, and fall. They have been observed swimming or basking on the surface as far as the Gulf Stream, 104 km (62.4 mi) offshore, and are seen regularly as close as the creeks and tidal rivers of Georgia’s extensive saltmarshes. Loggerheads are Georgia’s primary nesting sea turtle, laying eggs on the beaches of every barrier island during the summer nesting season” (GADNR, 2011d). Critical habitat has been designated in Georgia along the beaches of coastal barrier islands, including Little Tybee Island, Wassaw Island, Ossabaw Island, St. Catherines Island, Blackbeard Island, Sapelo Island, Little Cumberland Island, and Cumberland Island (USFWS, 2015y).

Loggerhead sea turtles are found in the open sea and in inshore areas such as salt marshes, creeks, bays, and lagoons. Current threats to the loggerhead sea turtle include incidental captures in fishing gear, direct harvesting of eggs, and habitat loss and degradation (NOAA, 2014c) (USFWS, 2008a). “Boat strikes are responsible for approximately 15 percent of known loggerhead mortalities in Georgia. Natural predation on eggs and hatchlings can be very high on Georgia beaches that lack nest protection programs” (GADNR, 2011d).

**Birds**

One endangered and three threatened avian species are federally listed and known to occur in the state of Georgia as summarized in Table 6.1.6-6. The piping plover (*Charadrius melodus*) and red knot (*Calidris canutus rufa*) are found along the Georgia coast, while the red-cockaded woodpecker (*Picoides borealis*) and wood stork (*Mycteria americana*) are found across the Georgia coastal plain region (USFWS, 2015c). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

**Table 6.1.6-6: Federally Listed Bird Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Piping Plover	<i>Charadrius melodus</i>	Threatened	Yes, critical habitat has been designated along Georgia’s barrier islands.	Intertidal zone of ocean beaches, ocean washover areas, mudflats, sand flats, wrack lines, and the shorelines of coastal ponds, lagoons, and salt marshes; found along the coast of Georgia.
Red-cockaded Woodpecker	<i>Picoides borealis</i>	Endangered	No	Mature pine forests; found in south-central and southern Georgia.
Red Knot	<i>Calidris canutus rufa</i>	Threatened	No	Intertidal marines, estuaries, and bays; found along the coast of Georgia.
Wood Stork	<i>Mycteria americana</i>	Threatened	No	Primarily feed in fresh and brackish wetlands and nest in cypress or other wooded swamps.

Source: (USFWS, 2015c) (USFWS, 2016a)

**Piping Plover.** The piping plover (*Charadrius melodus*) is a small, pale brown-colored shorebird with a short beak and black band across its forehead, measuring approximately 7.25 inches in length. The piping plover was 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 range in the U.S., which includes the Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, and the Virgin Islands (50 FR 50726 50734, December 11, 1985). (USFWS, 2015z)

“Barrier islands along the Georgia and South Carolina coasts are a major wintering area for this species, and a few of Georgia’s barrier islands, particularly Little Egg Island Bar and Little St. Simons Island, harbor a substantial number of wintering individuals from the Great Lakes breeding population” (GADNR, 2010a). Critical habitat for the wintering birds has been designated in Georgia along the beaches of coastal barrier islands, including Tybee Island, Little Tybee Island, North Wassaw Island, South Wassaw Island, Ossabaw Island, St. Catherines Island Bar, McQueen’s Inlet, St. Catherines Island Bar, Blackbeard Island, Sapelo Island, Wolf Island, Egg Island Bar, Little St. Simons Island, Sea/St. Simon’s Island, Jekyll Island, and Cumberland Island. Piping plover are found on open, sandy beaches and on tidal mudflats and sandflats along both the Atlantic and Gulf coasts (USFWS, 2001b). Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers. Nesting often occurs in wetlands in the Northern Great Plains. They feed on worms, fly larvae, beetles, crustaceans, and other marine macroinvertebrates. Current threats to this species include habitat loss and habitat degradation, human disturbance, pets, predation, flooding from coastal storms, and environmental contaminants (USFWS, 2015aa) (USFWS, 2015ab).

**Red-cockaded Woodpecker.** The red-cockaded woodpecker (*Picoides borealis*) is a small black and white woodpecker that grows approximately seven inches with a wingspan of about 15 inches. It is characterized by its black cap and white cheek patches. Male red-cockaded woodpeckers have “rarely visible” red markings on the side of their neck (USFWS, 2015ac). The red-cockaded woodpecker was listed as endangered in 1970 under early endangered species legislation (35 FR 16047 16048, October 13, 1970) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.). Regionally, this species is known to occur in open pine forests in the southeast from Virginia south to Florida and west to Oklahoma and Texas. In Georgia, the red-cockaded woodpecker is known to occur in 31 counties across the southern part of the state (USFWS, 2015ad). “Georgia has five remaining population centers that contain the majority of the state’s red-cockaded woodpecker population including Fort Benning, Fort Stewart, Okefenokee National Wildlife Refuge, Piedmont National Wildlife Refuge/Breder Experimental Forest/Oconee National Forest, and plantations in the Red Hills region of Thomas and Grady Counties where red-cockaded woodpecker habitat maintenance had been incidental to land management for quail hunting and aesthetics. A few scattered groups may remain elsewhere on private land” (GADNR, 2010b).



Photo credit: USFWS

**Red-Cockaded Woodpecker**

The preferred habitat for the red-cockaded woodpecker is mature pine forests, preferring longleaf pines (*Pinus palustris*). Red-cockaded woodpeckers forage on insects by pecking pine trunks and branches and flaking away bark. Its diet is primarily composed of insects, with occasional wild fruits and pine seeds. Current threats to the red-cockaded woodpecker include lack of suitable habitats (USFWS, 2003a).

**Red Knot.** The red knot (*Calidris canutus rufa*) is approximately 9 inches in length with a wing span up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005). It was recently federally listed as a threatened species 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. During spring and fall migration, the red knot travels in “non-stop segments of 1,500 miles and more, converging on critical stopover areas to rest and refuel along the way” (USFWS, 2013b). Some red knots have been documented to migrate 9,300 miles from south to north in the spring (USFWS, 2005) (USFWS, 2014c). The species is known from the five coastal Georgia counties (Camden, Chatham, Glynn, Liberty, and McIntosh Counties) (USFWS, 2015ae).



Red knot

Photo credit: USFWS

The preferred habitat is for the red knot intertidal marines, estuaries, and bays. Mussel beds are important food sources for the red knot. Red knots eat mussels and other mollusks almost all year, however during migration season they “juvenile clams and mussels and horseshoe crab eggs” (USFWS, 2013b). “Knots can be found on any Georgia barrier beach, but Little Tybee, Wassaw, St. Catherines, Blackbeard, Sapelo, Little St. Simons, and Cumberland Islands, as well as St. Catherines Island Bar are the locations most often used in the winter and spring, while Wolf Island, Little Egg Island Bar, and Little St. Simons Island at the mouth of the Altamaha River support the only known late summer and fall staging site on the east coast of the U.S., attracting as many as 12,000 knots at one time” (GADNR, 2010c). Current threats to the red knot include sea level rise, coastal development; shoreline stabilization; dredging; reduced food availability at their migration stopovers; and disturbance by humans, dogs, vehicles, and climate change (USFWS, 2014c) (USFWS, 2016b).

**Wood Stork.** The wood stork (*Mycteria americana*) is a large, long-legged wading bird, about 50 inches tall, with a wingspan of 60 to 65 inches. The plumage is white except for black primaries and secondaries and a short black tail. The head and neck are largely unfeathered and dark gray in color. The bill is black, thick at the base, and slightly decurved. Immature birds are dingy gray and have a yellowish bill (USFWS, 2015af). The bird was federally listed as a threatened species in 1984 (49 FR 7332 7335, February 28, 1984). The wood stork is the only stork regularly occurring in the United States. The breeding range of the species extends from the southeastern United States south through Mexico and Central America, Cuba and Hispaniola, and through South America to western Ecuador, eastern Peru, Bolivia, and northern Argentina

(USFWS, 1997b). The species is known from 77 counties in the southern and eastern Georgia coastal plain (USFWS, 2015af).

The preferred habitat includes a variety of freshwater and estuarine wetlands for nesting, feeding, and roosting. Freshwater colony sites must remain inundated throughout the nesting cycle to protect against predation and abandonment. Foraging sites occur in shallow, open water where prey concentrations are high, such as freshwater marshes, roadside and agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads or swamp sloughs (USFWS, 1997b). This species was first recorded nesting in Georgia in 1965 at Blackbeard Island National Wildlife Refuge (NWR). “Breeding colonies have been documented at least once at 56 different locations in 18 counties along the coast and across the eastern and central portion of southern Georgia. Following the breeding season, wood storks may disperse northward to North Carolina, Tennessee, and Arkansas. A few wood storks may be seen in the Georgia Piedmont, well north of breeding colonies, during late summer and fall, but the most heavily used habitat during fall is the coastal marshes” (GADNR, 2010d).

Current threats to the wood stork include loss of feeding habitat, water level manipulations affecting drainage, predation, and/or lack of nest tree regeneration, human disturbance, and pesticides/chemical pollutants (USFWS, 1997b).

### Amphibians

One endangered and one threatened amphibian species are federally listed and known to occur in the state of Georgia as summarized in Table 6.1.6-7. The threatened frosted flatwoods salamander (*Ambystoma cingulatum*) and the endangered reticulated flatwoods salamander (*Ambystoma bishopi*) occur in the coastal plain of Georgia (USFWS, 2015c). The striped newt (*Notophthalmus perstriatus*) has been identified as a candidate species in Georgia (USFWS, 2014b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

**Table 6.1.6-7: Federally Listed Amphibian Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Frosted Flatwoods Salamander	<i>Ambystoma cingulatum</i>	Threatened	No	Breeds in isolated pond cypress dominated depressions generally within pine forests. A relatively open canopy resulting from seasonal prescribed burns is necessary to maintain appropriate vegetation.
Reticulated Flatwoods Salamander	<i>Ambystoma bishopi</i>	Endangered	Yes, critical habitat has been designated at two locations in SW Georgia.	Breeds in isolated pond cypress dominated depressions generally within pine forests. A relatively open canopy resulting from seasonal prescribed burns is necessary to maintain appropriate vegetation.

Source: (USFWS, 2015c) (USFWS, 2016a)

**Frosted Flatwoods Salamander.** The frosted flatwoods salamander (*Ambystoma cingulatum*) typically reaches an adult length of 5 inches. Body color ranges from silvery gray to black, with the back heavily mottled with a variable gray cross-band pattern. The underside is plain gray

with faint creamy blotches. The species was listed as threatened in 1999 (64 FR 15691 15704, April 1, 1999). Its range includes coastal plain areas Florida, Georgia, and South Carolina. In Georgia, frosted flatwoods salamander is known to occur in nine counties in the southeastern portion of the state (USFWS, 2015ag). USFWS has not designated critical habitat for the frosted flatwoods salamander in Georgia (USFWS, 2015d).

Preferred habitat of the frosted flatwoods salamander includes historically longleaf pine and wiregrass flatwoods and savannas in the lower southeastern Coastal Plain. Adults are terrestrial and live underground most of the year. “They breed in relatively small, isolated ephemeral ponds where the larvae develop until metamorphosis. Post-metamorphic salamanders migrate out of the ponds and into the uplands where they live until they move back to ponds to breed as adults” (USFWS, 2009b). In Georgia, “[n]early all flatwoods salamander sites currently dominated by slash pine have been converted from historic longleaf pine stands. Pine flatwoods are fire-dependent communities, requiring periodic burns to promote grasses and forbs, while limiting shrubs and hardwoods” (GADNR, 2009i).

Threats to the frosted flatwoods salamander include destruction and modification of the pine flatwoods habitat (including fire suppression) and disease/predation (USFWS, 2009b). In Georgia, “forestry practices altering hydrology by ditching, draining, and/or bedding[,] are detrimental to both the fossorial and aquatic existence of this species and may interfere with successful migration...Fire suppression throughout the Coastal Plain has also reduced the amount of suitable habitat” (GADNR, 2009i).

***Reticulated Flatwoods Salamander.*** The reticulated flatwoods salamander (*Ambystoma bishopi*) is a medium-sized salamander, slightly smaller than the frosted flatwoods salamander, reaching an adult length of about 5 inches. Body color ranges from black to chocolate-black, with fine, irregular light gray lines and specks that form a net-like cross-banded pattern across their backs (USFWS, 2009b). The species was listed as endangered in 2009 (74 FR 6700 6774, February 10, 2009). Its range includes coastal plain areas in Florida and Georgia. In Georgia, reticulated flatwoods salamander is known to occur in Baker and Miller Counties in the southwestern portion of the state (USFWS, 2015ag). USFWS has designated critical habitat necessary for the continued survival and recovery of the frosted flatwoods salamander in Florida and Georgia (USFWS, 2015d). Critical habitat in Georgia consists of two areas totaling 784 acres in Miller and Baker Counties (USFWS, 2009b).

Preferred habitat of the reticulated flatwoods salamander is the same as that of the frosted flatwoods salamander and includes historically longleaf pine and wiregrass flatwoods and savannas in the lower southeastern Coastal Plain. Reticulated flatwoods salamanders generally occur west of the Apalachicola River drainage basin, while frosted flatwoods salamanders occur east of this basin. Adults are terrestrial and live underground most of the year. They breed in relatively small, isolated ephemeral ponds where the larvae develop until metamorphosis. Post-metamorphic salamanders migrate out of the ponds and into the uplands where they live until they move back to ponds to breed as adults (USFWS, 2009b). In Georgia, “[n]early all flatwoods salamander sites currently dominated by slash pine have been converted from historic

longleaf pine stands. Pine flatwoods are fire-dependent communities, requiring periodic burns to promote grasses and forbs, while limiting shrubs and hardwoods” (GADNR, 2009i).

Threats to the reticulated flatwoods salamander include destruction and modification of the pine flatwoods habitat (including fire suppression) and disease/predation (USFWS, 2009b). In Georgia, “forestry practices often involve altering the hydrology by ditching, draining, and/or bedding. These activities are detrimental to both the fossorial and aquatic existence of this species and may interfere with successful migration...Fire suppression throughout the Coastal Plain has also reduced the amount of suitable habitat” (GADNR, 2009i).

**Fish**

Five endangered and four threatened fish species are federally listed and known to occur in Georgia, as summarized in Table 6.1.6-8. The amber darter (*Percina antesella*), blue shiner (*Cyprinella caerulea*), Cherokee darter (*Etheostoma scotti*), Conasauga logperch (*Percina jenkinsi*), Etowah darter (*Etheostoma etowahae*), goldline darter (*Percina aurolineata*), and snail darter (*Percina tanasi*) are all found in northwest Georgia. The shortnose sturgeon (*Acipenser brevirostrum*) is found in coastal plain rivers in south and east Georgia, and the smalltooth sawfish (*Pristis pectinata*) is found in the coastal Georgia counties (USFWS, 2015c). The sicklefin redhorse (*Moxostoma* sp.) has been identified as a candidate species in Georgia (USFWS, 2014b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

**Table 6.1.6-8: Federally Listed Fish Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Amber Darter	<i>Percina antesella</i>	Endangered	Yes, in the Conasauga River in Murray and Whitfield Counties, northwest Georgia.	Gentle riffle areas over sand and gravel substrate that becomes vegetated.
Blue Shiner	<i>Cyprinella caerulea</i>	Threatened	No	Pool areas with flowing water and substrates of rubble, gravel and sand.
Cherokee Darter	<i>Etheostoma scotti</i>	Threatened	No	Small to medium size creeks of moderate gradient in low current areas with large gravel, cobble, and small boulder substrates.
Conasauga Logperch	<i>Percina jenkinsi</i>	Endangered	Yes, in the Conasauga River in Murray and Whitfield Counties, northwest Georgia.	Flowing pool areas and riffles over clean substrate of rubble, sand, and gravel.
Etowah Darter	<i>Etheostoma etowahae</i>	Endangered	No	Medium to larger creeks and small rivers of moderate to high gradient in swift current areas in riffles with large gravel, cobble, and small boulder substrates.
Goldline Darter	<i>Percina aurolineata</i>	Threatened	No	Moderate to swift current over sand or gravel substrate interspersed among cobble and small boulders.

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	Endangered	No	Nearshore marine, estuarine, and riverine habitats; in Georgia, found in coastal rivers (primarily Altamaha, Ogeechee, Savannah Rivers).
Smalltooth Sawfish	<i>Pristis pectinata</i>	Endangered	No	Shallow coastal waters of warm seas.
Snail Darter	<i>Percina tanasi</i>	Threatened	No	Larger creeks and small rivers, where it occurs in areas with moderate to swift flow over mixed sand and gravel.

Source: (USFWS, 2015c) (USFWS, 2016a)

**Amber Darter.** The endangered amber darter (*Percina antesella*) is a short, slender-bodied fish generally less than 2.5 inches in length. The upper body is golden brown with dark saddle-like markings, and its belly is yellow to cream in color. The throats of breeding males are blue in color. This species was listed as endangered in 1985 (50 FR 31597 31604, August 5, 1985). In Georgia, it is found in the Conasauga and Etowah Rivers in the northwest portion of the state (USFWS, 1985) (USFWS, 2015ah). USFWS has designated critical habitat necessary for the continued survival and recovery of the amber darter in Tennessee and Georgia (USFWS, 2015d). Critical habitat in Georgia consists of the Conasauga River in Murray and Whitfield Counties from the Tennessee state line south to the Tibbs Bridge Road bridge (USFWS, 1985).

The preferred habitats are gentle riffle areas over sand and gravel substrate, with aquatic vegetation in the summer season for feeding (USFWS, 1985). “Amber darters rarely occur in [very shallow or low-velocity areas], or areas with accumulated silt...Amber darters burrow into loose gravel and sand, possibly to hide from predators” (GADNR, 2010e).

Current threats to this species include increased silvicultural activity, road and bridge construction, stream channel modifications, impoundments, changes in land use, and other projects in the watershed, if such activities are not planned and implemented with the survival of the species and the protection (USFWS, 1985). “Suburban development remains fairly restricted in the upper Conasauga system, where non-point source pollution from agricultural lands may be significant...Commercial and road construction, and increased stormwater runoff from impervious areas” are also threats in Georgia (GADNR, 2010e).

**Blue Shiner.** The threatened blue shiner (*Cyprinella caerulea*) is a medium sized minnow up to 4 inches in length. It is dusky blue in color with pale yellow fins. It has a distinct lateral line and diamond-shaped scales. This species was listed as threatened in 1992 (57 FR 14786 14790, April 22, 1992). In Georgia, it is found in six counties in the northwest portion of the state in the Conasauga and Coosawattee River basins (USFWS, 1992a) (USFWS, 2015ai).

The preferred habitat for the blue shiner is sand and gravel substrate among cobble in cool, clear water (USFWS, 1992a). Blue shiners are sometimes associated with submerged tree roots and fallen branches. They also occur near water willow (*Justicia americana*) beds, especially in eddy currents downstream from the beds (USFWS, 1995).

Current threats to this species include water quality degradation, point- and non-point source water pollution, excessive turbidity, and dam construction (USFWS, 1995). In Georgia, “[s]tream degradation resulting from failure to employ Best Management Practices (BMPs) for forestry and agriculture, failure to control soil erosion from construction sites and bridge crossings, and increased stormwater runoff from developing urban and industrial areas further threaten the blue shiner where populations still exist” (GADNR, 2008a).

**Cherokee Darter.** The threatened Cherokee darter (*Etheostoma scotti*) is a small percid fish that is white to pale yellow with eight dark olive black blotches on its sides. The back usually has eight small dark saddles and intervening pale areas (USFWS, 1994a) (USFWS, 2000). This species was listed as threatened in 1994 (59 FR 65505 65512, December 20, 1994). The species is endemic to Georgia and is found in the Etowah River system in 15 counties in northwest Georgia (USFWS, 2015aj).

The preferred habitat for the Cherokee darter is small to medium size creeks of moderate gradient in low current areas with large gravel, cobble, and small boulder substrates (USFWS, 2000). It is usually found in shallow water in sections of reduced current, typically in runs above and below riffles and at the ecotones of backwaters. It is most abundant in stream sections with relatively clear water and clean substrates (little silt deposition). The species is intolerant of impoundments (USFWS, 1994a).

Current threats to this species include construction of impoundments and deteriorating water and benthic habitat quality resulting from siltation and other pollutants (USFWS, 2000). “Stream degradation results from failure to employ Best Management Practices (BMPs) for forestry and agriculture, failure to control soil erosion from construction sites and bridge crossings, and increased stormwater runoff from developing urban and industrial areas. Water development projects that impound streams [eliminate Cherokee darter populations]; continued persistence of a population within those tributary systems will depend on the size of the upstream unimpounded area” (GADNR, 2009j).

**Conasauga Logperch.** The endangered Conasauga logperch (*Percina jenkinsi*) is a larger darter, sometimes exceeding 6 inches in length. It is characterized by having many vertical dark stripes over a yellow body. This species was listed as endangered in 1985 (50 FR 31597 31604, August 5, 1985). In Georgia, it is found in the Conasauga River in the northwest portion of the state (USFWS, 1985) (USFWS, 2015ak). USFWS has designated critical habitat necessary for the continued survival and recovery of the Conasauga logperch in Tennessee and Georgia (USFWS, 2015d). Critical habitat in Georgia consists of the Conasauga River in Murray and Whitfield Counties from the Tennessee state line south to the Georgia State Highway 2 bridge in Murray County (USFWS, 1985).

The preferred habitats are flowing pool areas and riffles over clean substrate of rubble, sand, and gravel (USFWS, 1985). Current threats to this species include increased silvicultural activity, road and bridge construction, stream channel modifications, impoundments, changes in land use, and other projects in the watershed, if such activities are not planned and implemented with the survival of the species and the protection (USFWS, 1985). “The threat to this species is acute due to its extremely limited range – only [28 miles] of river within the entire upper Coosa River

basin. Development of water storage reservoirs adjacent to the Conasauga River may also adversely affect habitat conditions in the lower portion of the Conasauga logperch's range by altering stream flow and water temperatures" (GADNR, 2009k).

***Etowah Darter.*** The endangered Etowah darter (*Etheostoma etowahae*) is a small percid fish, 2 to 3 inches in length, with a moderately pointed snout and obliquely angled mouth. The body shade is brown or grayish-olive. The sides are usually pigmented with 13 to 14 small dark blotches just below the lateral line. The breast in breeding males is dark greenish-blue (USFWS, 1994a) (USFWS, 2000). This species was listed as endangered in 1994 (59 FR 65505 65512, December 20, 1994). The species is endemic to Georgia and is found in the Etowah River system in six counties in northwest Georgia (USFWS, 2015al).

The preferred habitat for the Etowah darter is medium to larger creeks and small rivers of moderate to high gradient in swift current areas in riffles with large gravel, cobble, and small boulder substrate (USFWS, 2000). The Etowah darter is typically associated with the swiftest portions of shallow riffles, but occasionally adults are taken at the tails of riffles. The sites having the greatest abundance of Etowah darters had clear water and relatively little silt in the riffles. The species is intolerant of impoundments (USFWS, 1994a).

Current threats to this species include deteriorating water and benthic habitat quality resulting from siltation and other pollutants (USFWS, 2000). "The Etowah darter is particularly vulnerable to habitat loss because of its narrow distribution, which is restricted to a geographic area currently experiencing rapid urban and suburban development as the metro-Atlanta area expands. Land disturbance associated with commercial development, and home and road construction threatens to degrade river and stream habitat by accelerating the runoff of sediment and contaminants" (GADNR, 2009l).

***Goldline Darter.*** The threatened goldline darter (*Percina aurolineata*) is a slender, small-sized fish, about 3 inches long with brownish-red stripes. It differs from other members of the subgenus *Hadropterus* in the color pattern of its back, which is pale to dusky. This species was listed as threatened in 1992 (57 FR 14786 14790, April 22, 1992). In Georgia, it is found or believed to occur in eight counties in the northwest portion of the state (USFWS, 1992a) (USFWS, 2015am). No critical habitat has been designated is located in Georgia for this species (USFWS, 2015d).

"The goldline darter prefers a moderate to swift current and water depths greater than 2 feet" (USFWS, 1992a). Current threats include water quality degradation resulting from urbanization, mining, land use, and sewage (GADNR, 2016b) "Increasing urbanization and residential development in the Coosawattee River system, resulting in deleterious effects on water quality and stream habitat, pose the major threat in Georgia. Stream bank trampling and nutrient enrichment associated with cattle grazing is also a significant threat to the population in the Ellijay River" (GADNR, 2009m).

***Shortnose Sturgeon.*** The endangered shortnose sturgeon (*Acipenser brevirostrum*) is the smallest of the three eastern North American sturgeon species, averaging approximately 3.5 feet in length and weighing up to 50 pounds. The shortnose sturgeon are long-lived fishes with

lifespans of 30 to 67 years and are among the most primitive of the bony fishes (NOAA, 2014d). This species was listed as endangered in 1967 (32 FR 4001, March 11, 1967). In Georgia, it is found primarily in the Altamaha, Ogeechee, and Savannah Rivers (NOAA, 2014d) (USFWS, 2015an). “The Altamaha River [in Georgia contains] the largest population south of the Delaware River” (GADNR, 2013).

The preferred habitats are nearshore marine, estuarine, and riverine habitats. Adult shortnose sturgeon feed on large crustaceans and mollusks, while juvenile sturgeon feed on small crustaceans and benthic insects. Females of this species can live up to 67 years and males approximately 30 years. This species spawns upstream in freshwater and then moves downstream and offshore to marine environments along the continental shelf. Historically, the shortnose sturgeon was not sought after by the commercial fishing industry, but was often taken incidentally during attempts for Atlantic sturgeon. Current threats to this species include pollution, overfishing, construction of dams, and dredging (NOAA, 2014d).

***Smalltooth Sawfish.*** The endangered smalltooth sawfish (*Pristis pectinata*) is in the ray family but in some respects appears to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. Sawfish snouts are extended as a long, narrow, flattened, rostral blade with a series of transverse teeth along either edge. The rostrum has a saw-like appearance and hence the name of sawfish. This species was listed as endangered in 2005 (70 FR 69464 69466, November 16, 2005). In the western Atlantic, the smalltooth sawfish has been reported from Brazil through the Caribbean and Central America, the Gulf of Mexico, and the Atlantic coast of the United States (USFWS, 2009c). In Georgia, the species is known from six coastal counties—Bryan, Camden, Chatham, Glynn, Liberty, and McIntosh Counties (USFWS, 2015ao).

The preferred habitats for the smalltooth sawfish are shallow coastal waters of warm seas. They are found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths (USFWS, 2009c).

The primary reason for the decline of the smalltooth sawfish population has been bycatch in various commercial and recreational fisheries. The secondary reason for the decline of the smalltooth sawfish population is habitat loss and degradation. Other threats to the species include entanglement in marine debris, injury from saw removal, pollution, and disturbance of natural behavior by divers and other marine activities (USFWS, 2009c).

***Snail Darter.*** The snail darter (*Percina tanasi*) is approximately 3 inches long. “Background color above the lateral line is brown with occasional faint traces of green” (USFWS, 1983). Four dark brown saddle-like marks cross the back of the fish and the lower part of its sides are lighter with dark blotches. Snail darters have a white belly, with dark brown coloring for the upper portion of their head. “The cheeks are mottled brown interspersed by traces of yellow” (USFWS, 1983). This species was originally listed as endangered in 1975 (40 FR 47505 47506, October 9, 1975) but was reclassified as threatened in 1984 (49 FR 27510 27514, July 5, 1984). The species occurs in Tennessee River tributaries in Alabama, Georgia, and Tennessee. In

Georgia, the species is only known from Chickamauga Creek in Catoosa County in northwest Georgia (USFWS, 2015ap).

The preferred habitat for the snail darter is cold water streams with rock shoals, small boulders, and areas of mixed sand and gravel (USFWS, 1983). “Extensive impoundment of the upper Tennessee River system has removed suitable habitat from most of the snail darter's native range. Isolated populations survive in larger tributaries where the principal threat is stream habitat degradation resulting from failure to employ Best Management Practices (BMPs) for forestry and agriculture, failure to control soil erosion from construction sites and bridge crossings, and increased stormwater runoff from developing urban and industrial areas” (GADNR, 2009n).

### **Invertebrates**

There are 12 endangered and three threatened invertebrate species that are federally listed and known to occur in the state of Georgia as summarized in Table 6.1.6-9. The Alabama moccasinshell (*Medionidus acutissimus*), Coosa moccasinshell (*Medionidus parvulus*), finelined pocketbook (*Lampsilis altilis*), Georgia pigtoe (*Pleurobema hanleyianum*), southern clubshell (*Pleurobema decisum*), southern pigtoe (*Pleurobema georgianum*), and triangular kidneyshell (*Ptychobranthus greenii*) occur in northwest Georgia. The fat threeridge (*Amblema neislerii*), Gulf moccasinshell (*Medionidus penicillatus*), Ochlockonee moccasinshell (*Medionidus simpsonianus*), oval pigtoe (*Pleurobema pyriforme*), purple bankclimber (*Elliptioideus sloatianus*), and shinyrayed pocketbook (*Lampsilis subangulata*) occur in western or southwestern Georgia. The Altamaha spinymussel (*Elliptio spinosa*) occurs in southeast Georgia. The Georgia interrupted rocksnail (*Leptoxis foremani*) occurs in northwest Georgia (USFWS, 2015c). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

Additionally, three mussel species do not occur on USFWS species lists for Georgia, but they have critical habitat defined within Georgia. The three species are the endangered ovate clubshell (*Pleurobema perovatum*), endangered southern acornshell (*Epioblasma othcaloogensis*), and endangered upland combshell (*Epioblasma metastrata*). The critical habitat for these three species includes the Oostanaula River/Coosawattee River/Conasauga River/Holly Creek area in Floyd, Gordon, Whitfield, and Murray Counties, Georgia; this is the same critical habitat defined for the Alabama moccasinshell, finelined pocketbook, Coosa moccasinshell, southern clubshell, southern pigtoe, and triangular kidneyshell mussels in Georgia. (69 FR 40084 40171, July 1, 2004)

**Table 6.1.6-9: Federally Listed Invertebrate Species of Georgia**

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Alabama Moccasinshell	<i>Medionidus acutissimus</i>	Threatened	Yes, in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers.
Altamaha Spiny mussel	<i>Elliptio spinosa</i>	Endangered	Yes, in the Altamaha River and major tributaries in southeast Georgia.	Stable, coarse-to-fine sandy sediments of sandbars, sloughs, and mid-channel islands.
Coosa Moccasinshell	<i>Medionidus parvulus</i>	Endangered	Yes, in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers.
Fat Threeridge Mussel	<i>Amblema neislerii</i>	Endangered	Yes, in the within the Lower Flint River watershed in southwest Georgia.	Main channel of small to large rivers in slow to moderate current.
Finelined Pocketbook	<i>Lampsilis altilis</i>	Threatened	Yes, in the Tallapoosa River and tributaries in Haralson and Paulding Counties, and in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Stable sand/gravel/cobble substrate in moderate to swift currents in small streams above the Fall Line.
Georgia Interrupted Rocksnail	<i>Leptoxis foremani</i>	Endangered	Yes, within the Oostanaula River in Gordon and Floyd Counties, Georgia.	Shoals, riffles, and reefs (bedrock outcrops) of medium to large rivers.
Georgia Pigtoe	<i>Pleurobema hanleyianum</i>	Endangered	Yes, within the Conasauga River in Whitfield and Murray Counties.	Shallow runs and riffles with strong to moderate current and coarse sand-gravel-cobble bottoms.
Gulf Moccasinshell	<i>Medionidus penicillatus</i>	Endangered	Yes, within the within the Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia.	Channels of small to medium-sized creeks to large rivers with sand and gravel or silty sand substrates in slow to moderate currents.
Ochlockonee Moccasinshell	<i>Medionidus simpsonianus</i>	Endangered	Yes, along the Ochlockonee River and several tributaries within Grady and Thomas Counties.	Large creeks and the Ochlockonee River main stem in areas with current, substrates are sand with some gravel.
Oval Pigtoe	<i>Pleurobema pyriforme</i>	Endangered	Yes, within the Upper Ochlockonee River, Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia.	Small to medium-sized creeks to small rivers where it inhabits silty sand to sand and gravel substrates, usually in slow to moderate current.

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Purple Bankclimber Mussel	<i>Elliptoideus sloatianus</i>	Threatened	Yes, within the Upper Ochlockonee River and the Upper, Middle, and Lower Flint River watersheds in southwest Georgia.	Small to large river channels in slow to moderate current over sand or sand mixed with mud or gravel substrates.
Shinyrayed Pocketbook	<i>Lampsilis subangulata</i>	Endangered	Yes, within the Upper Ochlockonee River, Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia.	Small to medium-sized creeks, to rivers in clean or silty sand substrates in slow to moderate current.
Southern Clubshell	<i>Pleurobema decisum</i>	Endangered	Yes, in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Sand/gravel/cobble substrate in shoals and runs of small rivers and large streams.
Southern Pigtoe	<i>Pleurobema georgianum</i>	Endangered	Yes, in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Sand/gravel/cobble substrate in shoals and runs of small rivers and large streams.
Triangular Kidneyshell	<i>Ptychobranchus greenii</i>	Endangered	Yes, in the Oostanaula, Coosawattee, and Conasauga Rivers and in Holly Creek in Georgia.	Sand/gravel/cobble substrate in shoals and runs of small rivers and large streams.

Source: (USFWS, 2015c) (USFWS, 2016a)

**Alabama Moccasinshell.** “The Alabama moccasinshell [*Medionidus acutissimus*] is a small, delicate species, approximately 30 mm (1.2 in) in length. The shell is narrowly elliptical, and thin, with a well-developed acute posterior ridge that terminates in an acute point on the posterior ventral margin. The posterior slope is finely corrugated. The periostracum is yellow to brownish yellow, with broken green rays across the entire surface of the shell. The thin nacre is translucent along the margins and salmon-colored in the umbos (beak cavity)” (USFWS, 2003b). The species was federally listed as threatened in 1993 (58 FR 14330 14340, March 17, 1993). Historically, the species is known to occur in Alabama, Mississippi, Georgia, and Tennessee in the Alabama River and tributaries, the Tombigbee River and tributaries, the Black Warrior River and tributaries, the Cahaba River, and the Coosa River and tributaries. In Georgia the species is known from six counties in northwest Georgia (USFWS, 2015aq). Critical habitat for the Alabama moccasinshell has been designated in Alabama, Mississippi, Georgia, and Tennessee; in Georgia, the critical habitat is within the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d).

The Alabama moccasinshell inhabits sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers (USFWS, 2000). Habitat modification, sedimentation, eutrophication, and degraded water quality are the primary causes of the decline of the Alabama moccasinshell (USFWS, 2015ar). In Georgia, “[e]xcess sedimentation due to inadequate riparian buffer zones, development, and agriculture covers suitable habitat and could potentially suffocate

mussels...Minimizing sedimentation in the Conasauga River and its tributaries is a key component to conserving the Alabama moccasinshell” (GADNR, 2008b).

**Altamaha Spiny mussel.** The Altamaha spiny mussel (*Elliptio spinosa*) has a shell length of approximately 4.3 inches. The shell is subrhomboidal or subtriangular in outline and moderately inflated. The shells are adorned with one to five prominent spines that may be straight or crooked, reach lengths from 0.4 to 1.0 inches, and are arranged in a single row that is somewhat parallel to the posterior ridge. In young specimens, the outside layer is greenish-yellow with faint greenish rays, but as the animals get older, they typically become a deep brown, although some raying may still be evident in older individuals. The interior layer of the shell (nacre) is pink or purplish (USFWS, 2011a). The species was federally listed as endangered in 2011 (76 FR 62928 62960, October 11, 2011). Historically, the species is known from the Altamaha River watershed in Georgia, where it is found in 36 counties in the southeastern portion of the state (USFWS, 2015as). Critical habitat for the Altamaha spiny mussel has been designated along the Altamaha River and several major tributaries within Georgia (USFWS, 2015d).

The Altamaha spiny mussel is considered a “big river” species and is associated with stable, coarse-to-fine sandy sediments of sandbars, sloughs, and mid-channel islands. The species appears to be restricted to swiftly flowing water (USFWS, 2011a). “Primary threats include “excess sedimentation due to inadequate riparian buffer zones [that] covers suitable habitat and could potentially suffocate mussels. Due to destabilization of the sand in some parts of the Altamaha River system, mussels that spend most of their time in the sand are being impacted negatively...Direct and indirect competition by the introduced flathead catfish may be reducing native mussel populations through direct consumption of mussels and their host fishes” (GADNR, 2011e).

**Coosa Moccasinshell.** The Coosa moccasinshell (*Medionidus parvulus*) is a thick elongated mussel occasionally exceeding 1.6 inches in length. The outer shell is yellow to dark brown with green rays, with a blue inner shell typically. Historically, the species range included rivers and creeks across Alabama, Georgia, and Tennessee. Presently in Georgia the species is known from six counties in northwest Georgia (USFWS, 2015at). Critical habitat for the Coosa moccasinshell has been designated in Alabama, Georgia, and Tennessee; in Georgia, the critical habitat is within the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d). The species was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993).

The Coosa moccasinshell inhabits small creeks and rivers with sand/gravel/cobble shoals having moderate to strong currents. Threats to this species include habitat modification, sedimentation, eutrophication, and water quality degradation (USFWS, 2000).

**Fat Threeridge Mussel.** The fat threeridge mussel (*Amblema neislerii*) is a medium-sized to large, subquadrate, inflated, solid, and heavy-shelled mussel that reaches a length of 4.0 inches. Large specimens are so inflated that their width approximates their height. The umbos (bulge or beak that protrudes near the hinge of a mussel) are in the anterior quarter of the shell. The dark brown to black shell is strongly sculptured with seven to eight prominent horizontal parallel plications (ridges). The inside surface of the shell (nacre) is bluish white to light purplish and

very iridescent (USFWS, 2003c). The species was federally listed as endangered in 1998 (63 FR 12664 12687, March 16, 1998). Historically, the species is known from the Apalachicola-Chattahoochee-Flint (ACF) watershed in Alabama, Georgia, and Florida. In Georgia, it is known from 20 counties in the southwestern portion of the state (USFWS, 2015au). Critical habitat for the fat threeridge has been designated in Alabama, Florida, and Georgia; in Georgia, the critical habitat is within the Lower Flint River watershed in southwest Georgia (USFWS, 2015d).

The fat threeridge mussel inhabits the main channel of small to large rivers in slow to moderate current (USFWS, 2003c). Threats to the species include excessive sediment bed loads of smaller sediment particles, changes in turbidity, increased suspended solids (primarily resulting from nonpoint-source loading from poor land-use practices, lack of BMPs, and maintenance of existing BMPs), and pesticides. Other primarily localized impacts include gravel mining, reduced water quality below dams, developmental activities, water withdrawal, impoundments, and alien species (USFWS, 2003c).

***Finelined Pocketbook.*** The finelined pocketbook (*Lampsilis atilis*) is a mussel, approximately 4 inches in length. The outer shell is yellow-brown with black fine rays, with a white iridescent inner shell (USFWS, 2000). The species was federally listed as threatened in 1993 (58 FR 14330 14340, March 17, 1993). Historically, the species is known from Alabama, Mississippi, Georgia, and Tennessee. In Georgia, the species is known from 22 counties in northwest Georgia (USFWS, 2015av). Critical habitat for the finelined pocketbook has been designated in Alabama, Georgia, and Tennessee; in Georgia, the critical habitat is within the Tallapoosa River in Haralson and Paulding Counties and within the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d).

The finelined pocketbook was historically found in large rivers to small creeks. Threats include habitat modification, sedimentation, eutrophication, and water quality degradation. This species cannot tolerate impoundments. Remaining populations are threatened by runoff from urban and agricultural practices, channel degradation, and drainage from mining, impoundment projects, and discharges from industrial and sewage treatment plants. (USFWS, 2008b) (USFWS, 2015aw) (NatureServe, 2009)

***Georgia Interrupted Rocksnail.*** The Georgia interrupted rocksnail (*Leptoxis foremani*) is a freshwater snail with an almost spherical shell growing to about 1 inch in length. The shell is thick, dark-brown to olive in color, and may have spots; typically has small ridges (USFWS, 2014d). The interrupted rocksnail was federally listed as endangered in 2010 (75 FR 67512, November 2, 2010).

Historically, the species occurred in the Coosa River drainage of Alabama and Georgia. In Georgia, the species currently is known from six counties in northwest Georgia. Critical habitat for the Georgia interrupted rocksnail has been designated in Alabama and Georgia; in Georgia, the critical habitat is within the Oostanaula River in Gordon and Floyd Counties (USFWS, 2015d). It is found in shoal, riffle, and reef habitats with a sand and boulder substrate with limited sediment and algae growth, and flowing water at depths less than 20 inches and slow-

moving currents. Threats include habitat deterioration and water quality degradation (USFWS, 2014e).

**Georgia Pigtoe.** The Georgia pigtoe (*Pleurobema hanleyianum*) grows 2 to 2.5 inches in length, and is oval and somewhat inflated. The surface of the shell is yellowish-tan to reddish-brown and may have concentric green rings, whereas the inner shell is white to light bluish-white (USFWS, 2015ax). The species was federally listed as endangered in 2010 (75 FR 67512 67550, November 2, 2010). The Georgia pigtoe was historically found in large creeks and rivers of the Coosa River drainage of Alabama, Georgia, and Tennessee. In Georgia, the species is known from six counties in the northwest part of the state (USFWS, 2015ax). Critical habitat for the Georgia pigtoe was designated at the time of listing in Alabama, Georgia, and Tennessee; in Georgia, the critical habitat is within the Conasauga River in Whitfield and Murray Counties (USFWS, 2015d).

Georgia pigtoe is found in shallow runs and riffles with strong to moderate current and coarse sand/gravel/cobble substrates. Threats to the species include range curtailment (the species currently only inhabits 27 river miles), dams and impoundments, water and habitat quality, and climate change. The 2014 Recovery Plan for the Georgia pigtoe, interrupted rocksnail, and rough hornshell, reports that the “[s]mall population sizes and limited distribution... make [these species] more vulnerable to drought, severe storm events, and other potential effects of climate change” (USFWS, 2014d).

**Gulf Moccasinshell.** The Gulf moccasinshell (*Medionidus penicillatus*) is a small mussel that reaches a length of about 2.2 inches, is elongate-elliptical or rhomboidal in outline, fairly inflated, and has relatively thin valves. The posterior ridge is rounded to slightly angle and intersects the end of the shell at the base line. Sculpturing (ridges/bumps on a shell caused by natural processes) consists of a series of thin, radially oriented plications along the length of the posterior slope. The remainder of the surface is smooth and yellowish to greenish brown with fine, typically interrupted green rays. Nacre color is smoky purple or greenish and slightly iridescent at the posterior end (USFWS, 2003c). The species was federally listed as endangered in 1998 (63 FR 12664 12687, March 16, 1998). The Gulf moccasinshell historically occurred in Econfinia Creek and in the ACF Basin. Apparently extirpated from the Apalachicola and Chattahoochee River main stems, this species currently occurs sporadically in Econfinia Creek, the Flint and Chipola River main stems, and in several ACF Basin tributaries in Alabama, Florida, and Georgia (USFWS, 2003c). In Georgia, it is known from 50 counties along the western and southwestern portion of the state (USFWS, 2015ay). Critical habitat for the gulf moccasinshell has been designated in Alabama, Florida, and Georgia; in Georgia, the critical habitat is within the Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia (USFWS, 2015d).

The Gulf moccasinshell inhabits the channels of small to medium-sized creeks to large rivers with sand and gravel or silty sand substrates in slow to moderate currents (USFWS, 2003c). Threats to the species include excessive sediment bed loads of smaller sediment particles, changes in turbidity, increased suspended solids (primarily resulting from nonpoint-source loading from poor land-use practices, lack of BMPs, and maintenance of existing BMPs), and

pesticides. Other primarily localized impacts include gravel mining, reduced water quality below dams, developmental activities, water withdrawal, impoundments, and alien species (USFWS, 2003c).

***Ochlockonee Moccasinshell.*** The Ochlockonee moccasinshell (*Medionidus simpsonianus*) is a small species, generally under 2.2 inches in length. It is slightly elongate-elliptical in outline, the posterior end obtusely rounded at the median line, and the ventral margin broadly curved. The posterior ridge is moderately angular and covered in its entire length with well developed, irregular plications. The periostracum (outside surface of the shell) is smooth. The color is light brown to yellowish green, with dark green rays formed by a series of connected chevrons or undulating lines across the length of the shell. The nacre is bluish white (USFWS, 2003c). The species was federally listed as endangered in 1998 (63 FR 12664 12687, March 16, 1998). The Ochlockonee moccasinshell occurred historically in the Ochlockonee River system in Florida and Georgia (USFWS, 2003c). In Georgia, it is known from six counties in the southwestern portion of the state (USFWS, 2015az). Critical habitat for the Ochlockonee moccasinshell has been designated in Florida and Georgia; in Georgia, the critical habitat is along the Ochlockonee River and several tributaries within Grady and Thomas Counties (USFWS, 2015d).

The Ochlockonee moccasinshell inhabits large creeks and the Ochlockonee River main stem in areas with current. Typical substrates are sand with some gravel (USFWS, 2003c). Threats to the species include excessive sediment bed loads of smaller sediment particles, changes in turbidity, increased suspended solids (primarily resulting from nonpoint-source loading from poor land-use practices, lack of BMPs, and maintenance of existing BMPs), and pesticides. Other primarily localized impacts include gravel mining, reduced water quality below dams, developmental activities, water withdrawal, impoundments, and alien species (USFWS, 2003c).

***Oval Pigtoe.*** The oval pigtoe (*Pleurobema pyriforme*) is a mussel that grows to approximately 2.5 inches in length. The yellowish, chestnut, or dark brown shell is shiny smooth with no rays and distinct growth lines (USFWS, 2003c). The Oval pigtoe was federally listed as endangered in 1998 (63 FR 12664 12687, March 16, 1998). The oval pigtoe was historically found in Econfina Creek, throughout the ACF Basin, and in the Ochlockonee and Suwannee River systems in Alabama, Georgia, and Florida. It has been extirpated from the main stems of the Apalachicola, Chattahoochee, and Suwannee Rivers (USFWS, 2003c). In Georgia, it is known from 50 counties in the western and southwestern portion of the state (USFWS, 2015ba). Critical habitat for the oval pigtoe has been designated in Alabama, Florida, and Georgia; in Georgia, the critical habitat was designated within the Upper Ochlockonee River, Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia (USFWS, 2015d).

Adult mussels are typically found in contained patches in streams and almost completely burrowed in the sediment. The oval pigtoe inhabits small to medium-sized creeks and rivers that are characterized by slow to moderate current and substrates that range from silty sand to sand and gravel. Threats to the Oval pigtoe include significant habitat loss, range restriction, and population fragmentation and size reduction due to erosive land practices, construction of new impoundments, water withdrawals, and nonnative species (USFWS, 2003d).

**Purple Bankclimber.** The purple bankclimber (*Elliptoideus sloatianus*) is a freshwater mussel, with heavy dark-colored shells with ridges, reaching a maximum length of about 8 inches (USFWS, 2003c). The purple bankclimber was federally listed as threatened in 1998 (63 FR 12664 12687, March 16, 1998). The species occurs in the Apalachicola, Flint, and Ochlockonee Rivers in Alabama, Florida, and Georgia (USFWS, 2003c). In Georgia, it is known from 81 counties in the western portion of the state (USFWS, 2015bb). In Georgia, critical habitat for the purple bankclimber has been designated within the Upper Ochlockonee River and the Upper, Middle, and Lower Flint River watersheds in the southwestern part of the state (USFWS, 2015d).

The purple bankclimber burrows into sediment of small to large river channels, in areas of slow to moderate current. It is commonly associated with substrates that consist of sand or sand mixed with mud or gravel. Threats to the purple bankclimber include significant habitat loss, range restriction, and population fragmentation and size reduction, due to erosive land practices, construction of new impoundments, water withdrawals, and nonnative species (USFWS, 2003c).

**Shinyrayed Pocketbook.** The shinyrayed pocketbook (*Lampsilis subangulata*) is a freshwater mussel that reaches about 3 inches in length. The smooth and shiny shell is relatively thin but solid, with a light yellowish brown color streaked in bright emerald rays over the length of the shell (USFWS, 2003c). The species was federally listed as threatened in 1998 (63 FR 12664 12687, March 16, 1998). The shinyrayed pocketbook historically occurred in the ACF Basin and Ochlockonee River systems and continues to occur at scattered localities in tributary streams of the ACF Basin and in the Ochlockonee River in Alabama, Florida, and Georgia (USFWS, 2003c). In Georgia, it is known from 50 counties in the western portion of the state (USFWS, 2015bc). Critical habitat for the shinyrayed pocketbook has been designated in Alabama, Florida and Georgia; in Georgia, the critical habitat is within the Upper Ochlockonee River, Upper, Middle, and Lower Flint River watersheds and Sawhatchee and Kirkland Creeks in southwest Georgia (USFWS, 2015d).

Adult mussels are typically found in clusters in streams, almost completely burrowed in the sediment. The shinyrayed pocketbook inhabits “small to medium-sized creeks to rivers in clean or silty sand substrates in slow to moderate current” (USFWS, 2003d). Threats to the Shinyrayed pocketbook include significant habitat loss, range restriction, and population fragmentation and size reduction due to erosive land practices, construction of new impoundments, water withdrawals, and nonnative species (USFWS, 2003d).

**Southern Clubshell.** The southern clubshell (*Pleurobema decisum*) grows to 2.8 inches long, with a thick shell, and heavy hinge plate and teeth. The shell outline is roughly rectangular. The posterior ridge ends abruptly with little development of the posterior slope at the dorsum of the shell. The outer surface color ranges from yellow to yellow-brown with occasional green rays or spots on the umbo in young specimens (USFWS, 2000). The species was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993). The species’ range extends through Alabama, Mississippi, and Georgia. In Georgia, the species is known or believed to occur in ten counties in the northwestern part of the state (USFWS, 2015bd). Critical habitat for the southern clubshell has been designated in Alabama, Mississippi, Georgia, and Tennessee. In Georgia, the

critical habitat is designated in the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d).

The southern clubshell inhabits sand/gravel/cobble substrate in shoals and runs of small rivers and large streams (USFWS, 2000). Habitat modification, sedimentation, and water quality degradation are the primary causes of decline of the southern clubshell. This species cannot tolerate impoundment or channelization. Surviving populations are threatened by channelization projects, household and agricultural runoff, and channel degradation caused by sand and gravel mining and/or channel maintenance projects (USFWS, 2000).

***Southern Pigtoe.*** The southern pigtoe (*Pleurobema georgianum*) is a freshwater mussel with yellow to yellow-brown elliptical shells that grows to about 2.4 inches (USFWS, 2000). The species was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993). Historically, the species is known from Alabama, Georgia, and Tennessee. In Georgia, the species is known or believed to occur in 16 counties in northwest Georgia (USFWS, 2015be). Critical habitat for the southern pigtoe has been designated in Alabama, Georgia, and Tennessee (69 FR 40084 40171, July 1, 2014). In Georgia, the critical habitat is designated in the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d).

The southern pigtoe inhabits sand/gravel/cobble substrates in small rivers and large streams. Threats to the species survival are sedimentation, eutrophication, and water quality degradation from domestic and agricultural runoff (USFWS, 2015be).

***Triangular Kidneyshell.*** The triangular kidneyshell (*Ptychobranchus greenii*) is a freshwater mussel with shells that are straw-yellow color in juveniles and yellow-brown in adults. The maximum adult shell length is about 4 inches. Historically, the species is known or believed to occur in Alabama, Georgia, and Tennessee. In Georgia, the species is known from ten counties in northwest Georgia (USFWS, 2015bf). The species was federally listed as endangered in 1993 (58 FR 14330 14340, March 17, 1993). Critical habitat for the triangular kidneyshell has been designated in Alabama, Georgia, and Tennessee; in Georgia, the critical habitat is within the Oostanaula River and several major tributaries in Floyd, Gordon, Whitfield, and Murray Counties (USFWS, 2015d).

The triangular kidneyshell inhabits “sand/gravel/cobble shoals and runs in small rivers and large streams” (USFWS, 2000). Primary threats to the species are “[h]abitat modification, sedimentation, eutrophication, and other forms of water quality degradation...[including]... urban and agricultural runoff, surface mine drainage, industrial and sewage treatment plant discharges, and localized household discharges” (USFWS, 2000).

## Plants

Nineteen endangered and eight threatened plant species are federally listed and known to occur in the state of Georgia as summarized in Table 6.1.6-10. The 27 plant species listed all have different ranges throughout the state of Georgia that range from the Appalachian Mountains in the north to the coastal plain in the south (USFWS, 2015c). The white fringeless orchid (*Platanthera integrilabia*) and Hirst brothers’ panic grass (*Dichantheium hirstii*) have been

identified as a candidate species in Georgia (USFWS, 2014b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Georgia is provided below.

**Table 6.1.6-10: Federally Listed Plant Species of Georgia**

<b>Common Name</b>	<b>Scientific Name</b>	<b>Federal Status</b>	<b>Critical Habitat in Georgia</b>	<b>Habitat Description</b>
Alabama Leather Flower	<i>Clematis socialis</i>	Endangered	No	Mesic flats near intermittent creeks with circumneutral or slightly basic soils and a high hydroperiod; in Georgia, only known from Floyd County.
American Chaffseed	<i>Schwalbea americana</i>	Endangered	No	Successional habitats; found in 17 counties in SW Georgia.
Black Spored Quillwort	<i>Isoetes melanospora</i>	Endangered	No	Eroded depressions formed on flat-to-doming granitic outcrops; known from 14 counties in north-central Georgia.
Canby's Dropwort	<i>Oxypolis canbyi</i>	Endangered	No	Open and sparse wetlands; known from 11 counties across central Georgia.
Cooley's Meadowrue	<i>Thalictrum cooleyi</i>	Endangered	No	Wet pine savannas, grass-sedge bogs, and savanna-like areas with circumneutral soils; in Georgia, Dougherty, Mitchell, and Worth Counties in the southwestern portion of the state.
Florida Torreya	<i>Torreya taxifolia</i>	Endangered	No	Bluffs, ravines, and steepheads; in Georgia, found in Decatur and Seminole Counties in the southwest corner of the state.
Fringed Campion	<i>Silene polypetala</i>	Endangered	No	Hardwood forests on fairly steep slopes of deep ravines or north-facing hillsides; in Georgia, the species is known from 17 counties in west-central and southwest part of the state.
Georgia Rockcress	<i>Arabis georgiana</i>	Threatened	Yes, in Clay, Floyd, Gordon, Harris, and Muscogee Counties, Georgia.	High bluffs along major river courses, with dry-mesic to mesic soils of open rocky woodland and forested slopes; found in western Georgia.
Green Pitcher-plant	<i>Sarracenia oreophila</i>	Endangered	No	Moist upland areas and along boggy, sandy streambanks; in Georgia, known from Gilmer, Towns and Union County, in the northern portion of the state.
Hairy Rattleweed	<i>Baptisia arachnifera</i>	Endangered	No	Low sandy ridges in open pine-palmetto woods; endemic to southeastern Georgia and is known from Brantley, Glynn, Pierce, and Wayne Counties.
Harperella	<i>Ptilimnium nodosum</i>	Endangered	No	Shallow ponds in hilly terrain and along gravelly stream-banks of swift moving water; found in 8 counties in central Georgia.
Kral's Waterplantain	<i>Sagittaria secundifolia</i>	Threatened	No	Frequently exposed shoals or rooted among loose boulders in quiet pools in rocky streams; in Georgia, only known from Chattooga County.

Common Name	Scientific Name	Federal Status	Critical Habitat in Georgia	Habitat Description
Large-flowered Skullcap	<i>Scutellaria montana</i>	Threatened	No	Rocky, submesic to xeric, well-drained, slightly acidic slope, ravine and stream bottom forests; in Georgia, the species is known from nine counties in the northwestern corner of the state.
Little Amphianthus	<i>Amphianthus pusillus</i>	Threatened	No	Eroded depressions formed on flat-to-doming granitic outcrops; known from 33 counties across central Georgia.
Mat-forming Quillwort	<i>Isoetes tegetiformans</i>	Endangered	No	Eroded depressions formed on flat-to-doming granitic outcrops; endemic to Georgia; known from Columbia, Greene, Hancock, Putnam, and Washington Counties in central Georgia.
Michaux's Sumac	<i>Rhus michauxii</i>	Endangered	No	Successional habitats; known from 61 counties in northern and central Georgia.
Mohr's Barbara Button	<i>Marshallia mohrii</i>	Threatened	No	Moist prairie-like openings in woodlands and along shale-bedded streams; in Georgia, found in Floyd and Walker Counties.
Persistent Trillium	<i>Trillium persistens</i>	Endangered	No	Deciduous or conifer-deciduous woods within ravines or gorges; species is known from Habersham, Rabun, and Stephens Counties in Georgia.
Pondberry	<i>Lindera melissifolia</i>	Endangered	No	Seasonally flooded wetlands, sandy sinks, pond margins, and swampy depressions; in Georgia, the species is known from eight counties in the southern portion of the state.
Relict Trillium	<i>Trillium reliquum</i>	Endangered	No	Moist hardwood forests that have had little or no disturbance in the recent past; in Georgia, known from 29 counties scattered across the central region of the state.
Rock Gnome Lichen	<i>Gymnoderma lineare</i>	Endangered	No	High-elevation cliffs or deep river gorges at lower levels on a variety of rocks; in Georgia, known only from Rabun County.
Small Whorled Pogonia	<i>Isotria medeoloides</i>	Threatened	No	Hardwood stands that include beech, birch, maple, oak, hemlock, and hickory; found in 7 counties in northeast Georgia.
Smooth Coneflower	<i>Echinacea laevigata</i>	Endangered	No	Open woods, glades, cedar barrens, dry limestone bluffs, and roadsides; known from five counties in northeast Georgia.
Swamp Pink	<i>Helonias bullata</i>	Threatened	No	Forested wetlands; in Georgia, known only from Rabun County.
Tennessee Yellow-eyed Grass	<i>Xyris tennesseensis</i>	Endangered	No	Wet spring meadows with open, sunny conditions, and calcareous bedrock; known from six counties in northwest Georgia.
Virginia Spiraea	<i>Spiraea virginiana</i>	Threatened	No	Rocky often flood scoured banks of high velocity streams and rivers; in Georgia, known only from Dade and Walker Counties in extreme northwest Georgia.
Whorled Sunflower	<i>Helianthus verticillatus</i>	Endangered	Yes, in Floyd County, Georgia.	Moist, prairie-like remnants, as openings in woodlands and adjacent to creeks; known in Georgia only from Floyd County.

Source: (USFWS, 2015c) (USFWS, 2016a)

**Alabama Leather Flower.** The Alabama leather flower (*Clematis socialis*) is a small herb that grows in clusters and can reach an average height of 12 inches. It is a rhizomatic plant that reproduces by sending out roots and one- to few-flowered lower shoots. The lower leaves are triangular or oval-shaped with a scale-like appearance and under half-an-inch long. The middle leaves are oval-shaped and grow up to 4.7 inches long; upper leaves are oval-shaped in groups of 3 to 5. The urn or bell-shaped flowers grow alone at the tips of slender stems and are usually a little more than an inch long and blue-violet in color. The fruits are one-seeded and 1.0 to 1.2 inches in length (USFWS, 2015bg). The Alabama leather flower was listed as endangered in 1986 (51 FR 34420 34422, September 26, 1986). The species is only known or believed to occur in two counties in northeast Alabama and one county in Georgia. In Georgia, it is known from only Floyd County in the northwest part of the state (USFWS, 2015bg).

It inhabits mesic flats in neutral or slightly basic silt and clay soils near irregularly occurring creeks. It prefers full sun or partial shade in grass, sedge, and rush communities. Threats to the Alabama leather flower include habitat destruction or modification and vulnerability due to the small number of populations that exist. (USFWS, 1989).

**American Chaffseed.** The American chaffseed (*Schwalbea Americana*) is a perennial that grows 12 to 24 inches high, with a cluster of large purple and yellow tubular flowers (USFWS, 2014f). The American chaffseed was listed as endangered in 1992 (57 FR 44703 44708, September 29, 1992). The American chaffseed is a coastal plain species and ranges throughout the Atlantic and Gulf coasts (USFWS, 2014f). In 2008, 53 known extant sites were recorded in this range. In Georgia, there were approximately 20 occurrences known in 2008, and the species is known to occur in 17 counties in Georgia (USFWS, 2008c) (USFWS, 2014f).

Suitable habitat for this species includes “pine flatwoods, fire-maintained savannas, and ecotonal areas between peaty wetlands and xeric (dry) sandy soils, bog borders, and other open grass-sedge systems” (USFWS, 1994b). “The American chaffseed occurs in sandy (sandy peat, sandy loam), acidic, and seasonally moist to dry soils...[and]... in species-rich plant communities where grasses, sedges, and savanna dicots are numerous” (USFWS, 1994b). Threats to the American chaffseed are loss of habitat due to development and natural vegetation succession (USFWS, 2014f).

**Black Spored Quillwort.** The black spored quillwort (*Isoetes melanospora*) is a rooted perennial with hollow, finely septate, linear leaves which are spirally arranged. Leaves are typically less than 2.75 inches long, but may extend up to 6 inches in length. The subterranean bases of the leaves are enlarged and overlapping. The leaf bases emanate from the upper portion of a short, squat, corm-like stem, which in this species is bibbed and typically somewhat shreddy. The mature megaspores are unique among Southeastern quillworts in that they are gray when dry, black when wet (USFWS, 1993a). The black spored quillwort was listed as endangered in 1988 (53 FR 3560 3565, February 5, 1988). The species is only known from Lancaster County, South Carolina, and 14 counties in north-central Georgia (USFWS, 2015bh).

Suitable habitat for this species is restricted to eroded depressions or (rarely) quarry pools formed on flat-to-doming granitic (either granite or granite-gneiss) outcrops. The species is found in depressions that have been eroded in the granite with an intact rim restricting drainage,

and with an accumulation of a few centimeters of mineral soil. Threats to the black spored quillwort include destruction of habitat due to quarrying activities, disturbance by farm animals, dumping on rock outcrops, vehicular traffic, recreational impacts (foot traffic, littering, and firebuilding on rock outcrops), hybridization, and extreme cold (USFWS, 1993a).

**Canby's Dropwort.** Canby's dropwort (*Oxypolis canbyi*) is a perennial herb which grows to heights between 2.5 and 4 feet. The plant's stems are thin and stiff, holding slender leaves and extending up to small, five-petal flower clusters with colors typically ranging from white to red (USFWS, 2011b). The species was federally listed as an endangered plant species in 1986 (51 FR 6690 6693, February 25, 1986). The species' range extends along Atlantic coastal states from Maryland to Georgia; in Georgia, the species known or believed to occur 11 counties within the central part of the state (USFWS, 2015bi).

Habitat for Canby's dropwort include open ponds, swamps, and sloughs, ultimately uninhibited by intensive canopy cover and on wet soils for a majority of the year. Wetland areas located near coastal regions with sandy or muddy upper soil layers provide adequate habitat for the species. Habitat loss, hydrologic alterations, environmental degradation from herbicides, and insect predation are all current threats to the species' survival (USFWS, 2011b).

**Cooley's Meadowrue.** The Cooley's meadowrue (*Thalictrum cooleyi*) is a tall herb (3 feet or more in flower), with the slender stems erect in sunny locations to lax or sprawling in shade, leaves ternately divided (lower leaves usually subdivided). Leaflets are about 0.8 inches long, mostly narrow (four or more times as long as wide), with entire (untoothed) margins or rarely with two to three lobes near the tip. All parts of the plant are glabrous (smooth) and have virtually no hairs or glands. Male and female flowers are on separate plants, in loose few-flowered clusters, appearing at the top of the plants in late June to early July (USFWS, 1994c). Cooley's meadowrue was listed as endangered in 1989 (54 FR 5935 5938, February 7, 1989). The species is known from occurrences in northwest Florida, southwest Georgia, and in coastal North Carolina; in Georgia, the species is known from Dougherty, Mitchell, and Worth Counties in the southwestern portion of the state (USFWS, 2015bj).

Suitable habitat for this species includes wet pine savannas, grass-sedge bogs, and savanna-like areas with circumneutral soils, in habitat kept open by frequent fire or other disturbance (clearings, the edges of frequently burned savannas, power line right-of-ways which are maintained either by fire or mowing, and roadside edges). Threats include habitat loss due to drainage, conversion to forestry, agriculture or development road building, and succession through fire suppression (USFWS, 1994c).

**Florida Torreya.** The Florida torreya (*Torreya taxifolia*) is a small, conical tree of the yew family with whorled branches. The evergreen, needle-like leaves are 1-1.5 inches long, stiff, sharply pointed at the tip, and are arranged on both sides of the twigs in a single plane. The leaves and twigs have a distinct pungent, resinous odor. Pollen cones and ovules are borne on separate trees (USFWS, 1986). Florida torreya was listed as endangered in 1984 (49 FR 2783 2786, January 23, 1984). The species is native to several counties along the Apalachicola River and Lake Seminole in northwest Florida and adjoining Georgia; in Georgia, the species is known

from Decatur and Seminole Counties in the southwest corner of the state (USFWS, 1986) (USFWS, 2015bk).

Suitable habitat for this species include bluffs, ravines, and steepheads (USFWS, 1986). In Georgia, the species is found in “rich, deciduous forests with beech and southern magnolia on mid-slopes of ravines and steepheads along the east side of Lake Seminole” (GADNR, 2010f). Threats include habitat alterations (logging, conversion of habitat to pine plantations), and fungal stem and needle blight (GADNR, 2010f) (USFWS, 1986).

**Fringed Campion.** The fringed campion (*Silene polypetala*) is a perennial herb that forms mats by spreading vegetatively, with long, slender stolon-like rhizomes and leafy offshoots, both of which terminate in overwintering clusters of leaves (rosettes). Leaves of the rosette and stem are opposite, widest toward the tip, mostly 1-4 inches long. Each rosette produces one to several erect flowering shoots, each of which is unbranched or sparingly branched, up to 16 inches tall. The flowers are arranged in groups of 3-5 at the top of the flowering shoot. The wide apex of each petal is divided into slender segments, giving the flower a fringed appearance. The petals are pink or white (USFWS, 1996a). Fringed campion was listed as endangered in 1991 (56 FR 1932 1936, January 18, 1991). The species is known from central and southwestern Georgia and northwestern Florida, with most populations occurring in the Apalachicola and Flint River watersheds; in Georgia, the species is known from 17 counties in west-central and southwest part of the state (USFWS, 1996a) (USFWS, 2015bl).

Suitable habitat for this species includes hardwood forests on fairly steep slopes of deep ravines or north-facing hillsides, sometimes on nearly level ground with circumneutral soils. Threats include clearing and degradation of land for urban/suburban, agricultural, and pine plantation purposes, impoundments, and grazing by deer (USFWS, 1996a).

**Georgia Rockcress.** The Georgia rockcress (*Arabis georgiana*) is a perennial herb up to 35 inches tall. Its leaves form a rosette and usually persist through the fruiting season with green lower surfaces. Its stem leaves are alternate, lance- or narrow-oval shaped (0.4 to 2.0 inches long), and somewhat clasping around the stems. The upper surfaces of the stem leaves have stiff, branched hairs when young but lose the hairs when mature. It typically has four white petals (0.2 to 0.4 inches long) (USFWS, 2013c). Georgia rockcress was listed as threatened in 2014 (79 FR 54627 54635, September 12, 2014). The species is found across central Alabama and western Georgia (USFWS, 2013c) (USFWS, 2015bm). Critical habitat for Georgia rockcress has been designated in Alabama and Georgia; in Georgia, the critical habitat is within Clay, Floyd, Gordon, Harris, and Muscogee Counties (79 FR 26679 26684, May 9, 2014) (USFWS, 2015d).

Suitable habitat for this species is characterized by includes high bluffs along major river courses, with dry-mesic to mesic soils of open rocky woodland and forested slopes...Georgia rockcress grows in a variety of dry situations, including shallow soil accumulations on rocky bluffs, ecotones of sloping rock outcrops, and sandy loam along eroding riverbanks” (USFWS, 2013c). Threats include habitat degradation, quarrying, timber harvesting, road building, grazing in areas where the plant exists, development (bridges, roads, houses, commercial buildings, or utility lines) and hydropower dam construction (USFWS, 2013c).

**Green Pitcher-plant.** The green pitcher-plant (*Sarracenia oreophila*) is a “carnivorous herb arising from moderately branched rhizomes. The species has two leaf types. The pitcher leaves (tubular leaves), which appear in spring, are 20-75 cm (8-30 in.) long, 6-10 cm (2.4-4.0 in.) in circumference at the orifice, and gradually narrow from the orifice to the base. Leaves are green to yellow-green with sunlit leaves sometimes maroon suffused, externally maroon veined, or, rarely, with a purple blotch at the orifice. A similarly colored hood arches over the orifice. The pitcher leaves wither by late summer, but are replaced by falcate phyllodia (flattened leaves), which persist until the next season. Flowers are borne singly on scapes 45-70 cm (18-28 in.) long. The petals are yellow. The fruit is a tuberculate capsule 1.5-1.8 cm (0.6-0.7 in.) wide” (USFWS, 2015bn). The green pitcher-plant was listed as endangered in 1979 (44 FR 54922 54923, September 21, 1979). The species is restricted to areas of the Cumberland Plateau and the Ridge and Valley Provinces in northeast Alabama and the Blue Ridge of Georgia and North Carolina. This species previously occurred in Coastal Plain and Piedmont areas in Alabama and Georgia and also in the Cumberland Plateau of eastern Tennessee (USFWS, 1994d). In Georgia, the species is known from Gilmer, Towns, and Union Counties, in the northern portion of the state (USFWS, 2015bn).

Suitable habitat for this species includes “moist upland areas and along boggy, sandy streambanks... [with soils that]... are generally acidic and derived from sandstones or shales” (USFWS, 1994d). Threats include clearing and degradation of land for various types of development, impoundments, trampling and soil disturbance by cattle, over-collection by botanists or commercial dealers, and fire suppression (USFWS, 1994d).

**Hairy Rattleweed.** The hairy rattleweed (*Baptisia arachnifera*) is a perennial legume from 20 to 30 inches tall, with simple heart-shaped leaves from 0.8 to 3 inches long. The yellow flowers are terminal, alternately arranged on the flowering stem, and 5-petaled. The entire plant, except parts of the flower, are covered with hairs (USFWS, 1984a). Hairy rattleweed was listed as endangered in 1978 (43 FR 17910 17916, April 26, 1978). The species is endemic to southeastern Georgia and is known from Brantley, Glynn, Pierce, and Wayne Counties (USFWS, 1984a) (USFWS, 2015bo).

Suitable habitat for this species is restricted low sandy ridges in open pine-palmetto woods with a shrubby layer of saw palmetto, gallberry, rusty lyonia, and blueberries; also pine plantations, powerlines, and rights-of-way through flatwoods habitats. “Threats include fire suppression, lowering of the water table, site drainage, and conversion of habitat to pine plantations” (GADNR, 2010g) (USFWS, 1984a).

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

Habitat for pond harperella consists of shallow ponds in hilly terrain and along gravelly stream-banks of swift moving water. Threats to harperella consist of water changes in flow, depth, and quality, along with human factors such as damming, hydrologic alterations, and development. Habitat destruction, either through overwhelming water coverage or severe dehydration, can detrimentally impact the species' survival (USFWS, 2015bp).

**Kral's Water-plantain.** The Kral's water-plantain (*Sagittaria secundifolia*) is "a submersed to emersed aquatic perennial arising from a stiff elongated rhizome up to 10 centimeters (cm) (4 inches) in length. The leaves are of two types, depending upon the velocity and depth of the water it inhabits. In swift shallows, the leaves are linear, rigid, and sickle-shaped; in quiet, deep waters, the leaves are longer and more quill-like. Separate male and female flowers are produced on a stalk, 10-50 cm (4-20 inches) long. The petals are inconspicuous in the female flowers; however, in the male flowers, they are white and 1.0-1.5 cm (0.4-0.6 inches) long" (USFWS, 1991a). Kral's water-plantain was listed as threatened in 1990 (55 FR 13907 13911, April 13, 1990). The species is known to occur in northwestern Georgia and in northern Alabama; in Georgia, the species is known from Chattooga County in the northwestern corner of the state (USFWS, 2015br).

Preferred habitat for Kral's water-plantain includes "frequently exposed shoals or rooted among loose boulders in quiet pools in rocky streams" (USFWS, 1991a). Significant threats to the species include loss and impact to habitat, including "[c]learing of the adjacent watershed for silvicultural, residential-recreational development, surface mining, or agricultural purposes..." (USFWS, 1991a).

**Large-flowered Skullcap.** The large-flowered skullcap (*Scutellaria montana*) is a perennial herb with solitary, erect, square stems, usually from 12 to 20 inches tall. The leaves are lanceolate to ovate, crenate to serrate margins, and hairy on both surfaces. The inflorescence is a terminal, leafy-bracted raceme, with or without paired lateral racemes at the base. The calyx is two-lobed (characteristic of the genus *Scutellaria*). The corolla is relatively large, 1 to 1.4 inches long, blue and white, and lacking a fleshy ridge (annulus) within the corolla tube near the top of the calyx. Flowering occurs from mid-May to early June and fruits mature in June and early July (USFWS, 1996b). The large-flowered skullcap was listed as threatened in 1986 (51 FR 22521 22524, June 20, 1986). The species is known to occur in northwestern Georgia and southeastern Tennessee; in Georgia, the species is known from nine counties in the northwestern corner of the state (USFWS, 2015bs).

Suitable habitat for this species includes rocky, submesic to xeric, well-drained, slightly acidic slope, ravine, and stream bottom forests in the Ridge and Valley and Cumberland Plateau provinces of Northwestern Georgia, and adjacent southeastern Tennessee (USFWS, 1996b). Threats include "quarrying, logging, cattle grazing and trampling, clearing for residential and commercial development, overbrowsing by deer, and competition by exotic pest plants such as Japanese honeysuckle" (GADNR, 2010h).

**Little Amphianthus.** The little amphianthus (*Amphianthus pusillus*) is "a small, aquatic annual with very short a small, aquatic annual with very short (to ca. 6 mm) (0.25 inch), leafy, rooted, submerged stems which produce flowers and one or more threadlike scapes. The tip of each

scape bears two small, ovate to lanceolate, oppositely arranged bracts. The scapes elongate as necessary (to Ca. 15 cm (6 inches)) to permit the bracts to float upon the surface of the water. A single small (to 4 mm (0.16 inch) long) white to pale purplish flower is borne between the two bracts. Other flowers borne on the usually submerged short stem are similar to the emerged flowers. The fruit is a small, shallowly bided capsule” (USFWS, 1993a). The little amphianthus was listed as threatened in 1988 (53 FR 3560 3565, February 5, 1988). The species’ range includes Alabama, Georgia, and South Carolina; in Georgia, the species is known from 33 counties across central Georgia (USFWS, 2015bt).

Suitable habitat for little amphianthus is “restricted to eroded depressions or (rarely) quarry pools formed on flat-to-doming granitic (either granite or granite-gneiss) outcrops” (USFWS, 1993a). The species is usually found in depressions that have been eroded in the granite with “an intact rim restricting drainage, and with an accumulation of a few centimeters of mineral soil” (USFWS, 1993a). Threats to little amphianthus include destruction of habitat due to quarrying activities, disturbance by farm animals, dumping on rock outcrops, vehicular traffic, recreational impacts (foot traffic, littering, and firebuilding on rock outcrops), and extreme cold. (USFWS, 1993a)

**Mat-forming Quillwort.** The mat-forming quillwort (*Isoetes tegetiformans*) is considered North America’s most distinctive quillwort, unique in its distichous leaf-arrangement (never spiraled); its matted growth form due to adventitious budding; and its unbranched, dimorphic roots. The leaves are typically less than 2.75 inches long, but in deeper water they may reach 6 inches. Its megaspores are tuberculate and brown (dark brown when wet) (USFWS, 1993a). The mat-forming quillwort was listed as endangered in 1988 (53 FR 3560 3565, February 5, 1988). The species is endemic to Georgia, occurring in Columbia, Greene, Hancock, Putnam, and Washington Counties in central Georgia (USFWS, 2015bu).

Suitable habitat for this species is restricted to eroded depressions or (rarely) quarry pools formed on flat-to-doming granitic (either granite or granite-gneiss) outcrops. The species is found in depressions that have been eroded in the granite with an intact rim restricting drainage, and with an accumulation of a few centimeters of mineral soil. Threats to the mat-forming quillwort include destruction of habitat due to quarrying activities, disturbance by farm animals, dumping on rock outcrops, vehicular traffic, recreational impacts (foot traffic, littering, and firebuilding on rock outcrops), and extreme cold (USFWS, 1993a).

**Michaux’s Sumac.** The Michaux’s sumac (*Rhus michauxii*), part of the cashew family, is a densely hairy shrub with one to three-foot stems and evenly serrated, oblong leaflets. The species contains male and female small greenish-yellow flowers within the same plant, which flower in June and July and produce a red drupe fruit in August through October (USFWS, 2015bv). Michaux’s sumac was listed as endangered in 1989 (54 FR 39850 39857, September 28, 1989). This species is distributed throughout the Atlantic coastal plains in the southern U.S. In 1993, only one population was known in Georgia, in Newton County south of Atlanta (USFWS, 1993b). In Georgia, the species is known from 61 counties in the northern and central part of the state (USFWS, 2015bv).

Suitable habitat consists of sandy or rocky open woods and survives best in areas where some form of disturbance has occurred, such as wildfire or maintained clearings. The most critical threat to this species is low reproductive capacity, fire suppression, and habitat loss due to development (USFWS, 2015bv).

***Mohr's Barbara's Button.*** The Mohr's Barbara's button (*Marshallia mohrii*) "is an erect perennial herb, 3 to 7 decimeters (1 to 2.3 feet) tall. The leaves are alternate, 8 to 20 cm (3.2 to 7.8 in.) long, firm-textured, three-nerved, and lanceolate-ovate in shape. Leaves are often clustered near the base and gradually reduce in size upwards. Inflorescences typically consist of several flowering heads in a branched arrangement. The heads are approximately 2.5 cm (1 in.) wide and consist of disk flowers (tubular in shape) that are pale pink or white in color. The fruit is an achene" (USFWS, 2015bw). Mohr's Barbara's button was listed as threatened in 1988 (53 FR 34698 34701, September 7, 1988). The species is known from Alabama and Georgia; in Georgia, the species is known or believed to occur in Floyd and Walker Counties in the northwestern part of the state (USFWS, 2015bw).

Suitable habitat is characterized by prairie-like openings in woodlands with moist soils, and banks near shale-bedded streams. The soils are sandy clays, which are alkaline, high in organic matter, and seasonally wet. Plants occur in full sun or partial shade in a grass-sedge community. Threats include application of herbicides, road expansion, and the use of ROWs for installation of utility lines. Habitat loss also occurs from conversion to agricultural or silvicultural uses (USFWS, 1991b).

***Persistent Trillium.*** The persistent trillium (*Trillium persistens*) is a "perennial herb with erect stems up to [12 inches] tall...[Leaves are] lance-shaped, dark green, in a whorl of [three] leaves at the top of the stem...[The flower stalk rises] from the center of the whorl of leaves, [and the flower has three petals, that are] delicate in texture with slightly wavy edges, white, turning pink-purple with age; 3 pale green sepals, slightly spreading, narrower than the petals, with bluntly pointed tips and pale edges; and 6 straight stamens with white stalks (filaments) and yellow pollen sacs (anthers)" (GADNR, 2010i). The persistent trillium was listed as endangered in 1978 (43 FR 17910 17916, May 27, 1978). The species is restricted to the Tallulah-Tugaloo River system in northeast Georgia and western South Carolina; in Georgia, the species is known from Habersham, Rabun, and Stephens Counties (USFWS, 1984b) (USFWS, 2015bx).

Suitable habitat for this species consists of deciduous or conifer-deciduous woods with a well-developed overstory within ravines or gorges, commonly under or near rhododendron, with well-decomposed litter and/or loose loam (USFWS, 1984b). In Georgia, the species is found in "[p]ine-hemlock-hardwood forests in ravines or along streams, often with rosebay or Carolina rhododendron or in lowbush blueberry thickets" (GADNR, 2010i). Threats to the species include impoundments, logging, wildfires, and recreational access (USFWS, 1984b).

***Pondberry.*** The pondberry (*Lindera melissifolia*) "is a deciduous shrub, growing from less than 1 foot (30 cm) to, infrequently, more than 6 feet (2 m) in height. Leaves are aromatic, alternate, elliptical, somewhat thin and membranaceous, with entire margins. Shrubs usually are sparsely branched, with fewer branches on smaller plants. Plants are rhizomatous, frequently propagating by vegetative sprouts and forming colonies. Plants are dioecious, each plant is a male or a

female, and produce clusters of small, yellow flowers in early spring prior to leaf development, from buds on branches produced from the growth during the preceding year. Immature fruits are drupes, green, and ripen to red by fall” (USFWS, 2015by).

Pondberry was listed as endangered in 1986 (51 FR 27495 27500, July 31, 1986). The species is known or believed to occur in Alabama, Arkansas, Georgia, Mississippi, Missouri, North Carolina, and South Carolina; in Georgia, the species is known from eight counties in the southern portion of the state (USFWS, 2015by).

Suitable habitat for this species includes 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, 1993c).

**Relict Trillium.** The relict trillium (*Trillium reliquum*) “is distinguished from other sessile-flowered members of the genus by its decumbent or S-curved stems, distinctively shaped anthers, and the color and shape of its leaves. The flowers appear in early spring and are greenish to brownish purple or occasionally pure yellow in color. The fruit is an oval-shaped, berry-like capsule that matures in early summer” (USFWS, 1991c). The relict trillium was listed as endangered in 1988 (53 FR 10879 10884, April 4, 1988). The species occurs primarily in undisturbed moist hardwood forests in limited portions of Alabama, Georgia, and South Carolina; in Georgia, the species is known from 29 counties across the central portion of the state (USFWS, 1991c) (USFWS, 2015bz).

Suitable habitat for the relict trillium includes “moist hardwood forests that have had little or no disturbance in the recent past. The soils on which it grows vary from rocky clays to alluvial sands, but all exhibit a high organic matter content in the upper soil layer. Most sites appear to be free from the influence of fire, both in the recent and distant past” (USFWS, 1991c). The plant is known to inhabit disturbed sites, such as utility, ROWs and agricultural areas (USFWS, 1991c). The most significant threat is the loss or alteration of habitat resulting from residential development. Other threats include conversion of habitat to silviculture and agriculture uses (USFWS, 1991c).

**Rock Gnome Lichen.** The endangered rock gnome lichen (*Gymnoderma lineare*) grows in dense colonies and contain small narrow blue-grey strap-like lobes (USFWS, 2015ca). The rock gnome lichen was listed as endangered in 1995 (60 FR 3557 3562, January 18, 1995). This species is known to occur throughout the Appalachian Mountains (USFWS, 2015ca). In Georgia, the rock gnome lichen is known only from Rabun County in the northeast corner of the state (USFWS, 2015cb).

Habitat for the rock gnome lichen is limited to vertical rock faces where water seeps flow during wet periods and generally occurs in areas of high elevation and with high humidity. The greatest threat to the rock gnome lichen is from human activities in recreational trail areas, as well as development, and lack of canopy shading (USFWS, 2015ca).

***Small Whorled Pogonia.*** The small whorled pogonia (*Isotria medeoloides*) is a member of the orchid family which grows between 10 to 14 inches in height with greenish yellow flowers (USFWS, 2008d). The small whorled pogonia was federally listed as endangered in 1982 (47 FR 39827 39831, September 9, 1982) and in 1994 was reclassified as threatened (59 FR 50852 50857, October 6, 1994). Regionally this species is known to occur in sparse distributions from Maine south to Georgia and eastern to Illinois (USFWS, 2015cc). In Georgia, the small whorled pogonia is known from seven counties in the northeast part of the state (USFWS, 2015cc).

The small whorled pogonia occurs in hardwood stands that include beech, birch, maple, oak, hemlock, and hickory that have an open understory, preferring acidic soils along small streams that have a thick layer of litter (USFWS, 2008d). One distinct feature of this species is that it can remain dormant underground for multiple years before reappearing (USFWS, 1992b). Current threats to small whorled pogonia include habitat loss due to urban expansion and forestry practices (USFWS, 2008d).

***Smooth Coneflower.*** The smooth coneflower (*Echinacea laevigata*) is a perennial herb in the aster family that grows up to 3.3 feet from a vertical root stock and basal leaves that may reach eight inches in length. The plant produces solitary flowers that are pink-purple and droop. Flowering occurs in late May through July and fruits develop in the summer months (USFWS, 2015cd). The smooth coneflower was listed as endangered in 1992 (57 FR 46340 46344, October 8, 1992). The distribution of the smooth coneflower is currently in Virginia, North Carolina, South Carolina, and Georgia, although it historically also occurred regionally throughout the southern U.S.; in Georgia, it is known from five counties in the northeast part of the state (USFWS, 2015cd).

The habitat of the smooth coneflower includes open woods, glades, cedar barrens, dry limestone bluffs, and roadsides. Optimal sites include soils rich in calcium and magnesium, and abundant sunlight. Threats to the species include fire suppression and habitat loss from development (USFWS, 2015cd).

***Swamp Pink.*** The swamp pink (*Helonias bullata*) is an obligate wetland species<sup>112</sup> in the lily family with fragrant pink wildflowers. Leaves are evergreen lance shaped that form circular clusters that lay flat on the ground. Flowers grow on one to three feet tall stalks in clusters of 30 to 50 individual small pink flowers with blue anthers (USFWS, 2015ce). The swamp pink was federally listed as threatened in 1988 (53 FR 35076 35080, September 9, 1988). The swamp pink is found on the coastal plains of three states (Delaware, New Jersey, and Maryland) and isolated spots of the southern Appalachian Mountains; within Georgia the species is known only from Rabun County in the extreme northeast corner of the state (USFWS, 2015ce).

Suitable habitats for the swamp pink consist of shaded forested wetland areas. Threats include human development that changes the physical and hydraulic conditions of the wetlands and invasive species (USFWS, 2015ce).

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<sup>112</sup>Obligate wetland species: "Almost always occur in wetlands. With few exceptions, these plants are found in standing water or seasonally saturated soils (14 or more consecutive days) near the surface." (USACE, 2012)

**Tennessee Yellow-eyed Grass.** The Tennessee yellow-eyed grass (*Xyris tennesseensis*) is “a perennial which typically occurs in clumps of few to many bulbous-based individuals. The soft, bulbous bases are comprised of small, dark outer scales and fleshy, white to rose or purplish inner scales. The leaves are all basal; the outermost ones are short and scalelike, whereas the others are linear, 9 to 45 centimeters (cm), or 3.5 to 18 inches (in.) long, and 0.15 to 1.0 cm (0.06 to 0.4 in.) wide.” The plant has “leafless, unbranched, flowering stalks each bearing a terminal, conelike inflorescence comprised of spirally arranged bracts enclosing small flowers with yellow or occasionally white petals” (USFWS, 1994b). The species was listed as endangered in 1991 (56 FR 34151 34154, July 26, 1991). The species is currently known or believed to occur in Alabama, Georgia, and Tennessee; in Georgia, the species is known from six counties in the northwestern portion of the state (USFWS, 2015cf).

“Suitable habitat for long-term survival of this species appears to be very limited. Populations are located in spring meadows or along small streams” (USFWS, 1994b). Threats to the species include timber management, drainage of lowland wetlands and conversion to agricultural fields, the impoundment of wetlands, herbicide spraying for weed control, and off-road vehicles. (USFWS, 1994b)

**Virginia Spiraea.** The Virginia spiraea (*Spiraea virginiana*) is a perennial shrub species with many branches. The shrub ranges in height from three to seven feet tall with elliptic leaves two to three inches long. The shrub’s white flowers appear in June and July at the ends of branches (WVDNR, 2015). The Virginia spiraea was first listed as threatened by endangered species legislation in 1990 (55 FR 24241 24247, June 15, 1990). Regionally the species occurs along 24 stream systems in Georgia, Tennessee, North Carolina, Kentucky, West Virginia, Virginia, and Ohio. In Georgia, it is known from Dade and Walker Counties in extreme northwest Georgia (USFWS, 2015cg).

The Virginia spiraea inhabits rocky often flood scoured banks of high velocity streams and rivers. It is believed that scour is important to the species as it discourages tree growth and prevents canopy closure. Flood frequency and intensity have a large influence on development of suitable habitat for the species. Major threats to the species include dam and reservoir construction that remove or eliminate the species habitat altogether. Damage to the plants from people using the river for recreation is another common threat. Physical damage to the plant stems from hikers, fishermen, boaters, and rafters has been observed at many documented sites of Virginia spiraea. This activity is often a result of an attempt to clear the river bank for fishing or camping sites (USFWS, 2015cg) (WVDNR, 2015).

**Whorled Sunflower.** The whorled sunflower (*Helianthus verticillatus*) “is a perennial arising from horizontal, tuberous-thickened roots with slender rhizomes. The stems are slender, erect, and up to 2 meters (m) (6 feet (ft.)) tall. The leaves are opposite on the lower stem, verticillate (whorled) in groups of 3 to 4 at the mid-stem, and alternate or opposite in the inflorescence at the end. Individual leaves are firm in texture and have a prominent mid-vein, but lack prominent lateral veins found in many members of the genus. The flowers are arranged in a branched inflorescence typically consisting of 3 to 7 heads” (USFWS, 2014g). The species was listed as endangered in 2014 (79 FR 44712 44718, August 1, 2014).

This species is a member of the sunflower family known or believed to occur in Cherokee County, Alabama; Floyd County, Georgia; and McNairy and Madison Counties, Tennessee, at the time of listing (USFWS, 2014g). In Georgia, the species is known only from Floyd County (USFWS, 2015ch). Critical habitat for the whorled sunflower has been designated in Alabama, Georgia, and Tennessee; in Georgia, the critical habitat is within the Coosa Valley Prairie in Floyd County (USFWS, 2015d).

Suitable habitat includes “moist, prairie-like remnants, which in a more natural condition exist as openings in woodlands and adjacent to creeks.” Threats to the species include mechanical or chemical vegetation management for industrial forestry, right-of-way maintenance, or agriculture; shading and competition resulting from vegetation succession; limited distribution and small population sizes (USFWS, 2014g).

### **6.1.7. Land Use, Recreation, and Airspace**

#### **6.1.7.1. Definition of the Resources**

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

#### **Land Use and Recreation**

Land use is defined as “the arrangements, activities and inputs people undertake in a certain land cover type to produce, change, or maintain it” (FAO, 2000). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth’s surface; land cover includes vegetation and manmade development (USGS, 1976).

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. (OECD, 2017)

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

#### **Airspace**

Airspace is generally defined as the space lying above the earth, above a certain area of land or water, or above a nation and the territories that it controls, including territorial waters (Merriam Webster Dictionary, 2015a). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace

management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The Federal Aviation Administration (FAA) is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

The FAA operates a network of airport towers, air route traffic control centers, and flight service stations. The FAA also develops air traffic rules, assigns use of airspace, and controls air traffic in U.S. airspace. "The Air Traffic Organization (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) (FAA, 2016a). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

### ***6.1.7.2. 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 Georgia. However, most site-specific land use controls and requirements are governed by local county, city, and town 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.

Because the Nation's airspace is governed by federal laws, there are no specific Georgia state laws that would alter the existing conditions relating to airspace for this PEIS. However, there are state statutes that address aviation in the Georgia Code, Title 6 (Georgia General Assembly, 2015).

### ***6.1.7.3. Land Use and Ownership***

For the purposes of this analysis, Georgia has been classified into primary land use groups based on coverage type as forest and woodlands, agricultural, developed land, and surface water. Land ownership within Georgia has been classified into three main categories: private, federal, and state. Table 6.1.7-1 identifies the major lands uses by coverage type in Georgia.

## Land Use

Forest and woodlands compose the largest portion of land use with 58 percent of Georgia’s total land area occupied by this category (Table 6.1.7-1 and Figure 6.1.7-1). Agriculture is the second largest area of land use with 19 percent of the total land area. Developed areas account for approximately 9 percent of the total land area (USGS, 2016c). The remaining percentages of land includes surface water at 3 percent and public land and other land covers at 11 percent, shown in Figure 6.1.7-1, that are not associated with specific land uses.

**Table 6.1.7-1: Major Land Use in Georgia by Coverage Type**

Land Use	Square Miles	Percent of Land
Forest and Woodland	33,131	58%
Agricultural Land	10,999	19%
Developed Land	5,311	9%
Surface Water	1,490	3%
Public Land and other Land Covers	6,582	11%

Source: (USGS, 2016c)

### *Forest and Woodland*

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural and developed areas. The largest concentrations of forest are in the north, central, and southeastern parts of the state. Most forest and woodland areas throughout Georgia are privately owned (approximately 54 percent). Section 6.1.6 presents additional information about terrestrial vegetation.

### State Forests

Georgia state forests encompass over 98 square miles of land. These forests are managed by the Georgia Forestry Commission and “operate under a multiple-use Forest Stewardship management plan taking into account the various wood product, wildlife, recreational, soil, water, aesthetic, historical, and cultural resources of the area.” (GFC, 2005a).

### Private Forest and Woodland

Over 18,000 square miles, or 54 percent of Georgia’s total forestland, is owned by private and corporate landowners. Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, jobs, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and public forests. For additional information regarding forest and woodland areas, see Section 6.1.6, Biological Resources and Section 6.1.8, Visual Resources.

### *Agricultural Land*

Agricultural land exists in every region of the state, with the largest concentrations in southern portion of the state (Figure 6.1.7-1). Just under 20 percent of Georgia’s total land area is classified as agricultural land (10,999 square miles). In 2012, there were 42,257 farms in Georgia and most were owned and operated by small, family businesses, with the average farm size of less than 100 acres (USDA, 2012). Some of the state’s largest agricultural uses include peanuts, cotton, rye, tobacco, corn, and soybeans. Other agricultural uses include livestock for dairy and meat, goats, sheep and hogs. For more information by county, access the USDA Census of Agriculture website:

[http://www.agcensus.usda.gov/Publications/2012/Full\\_Report/Census\\_by\\_State/Georgia/](http://www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Georgia/).

### *Developed Land*

Developed land in Georgia tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs. Although only nine percent of Georgia land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 6.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 6.1.7-1 shows where these areas are located within the Developed land use category.

**Table 6.1.7-2: Top Five Developed Metropolitan Areas**

<b>Metropolitan Area</b>	<b>Population Estimate</b>
Atlanta	4,515,419
Augusta-Richmond County (GA/SC)	283,283
Savannah	260,677
Columbus (GA/AL)	192,338
Macon	137,570
<b>Total Population of Georgia (2014)</b>	<b>10,097,343<sup>a</sup></b>

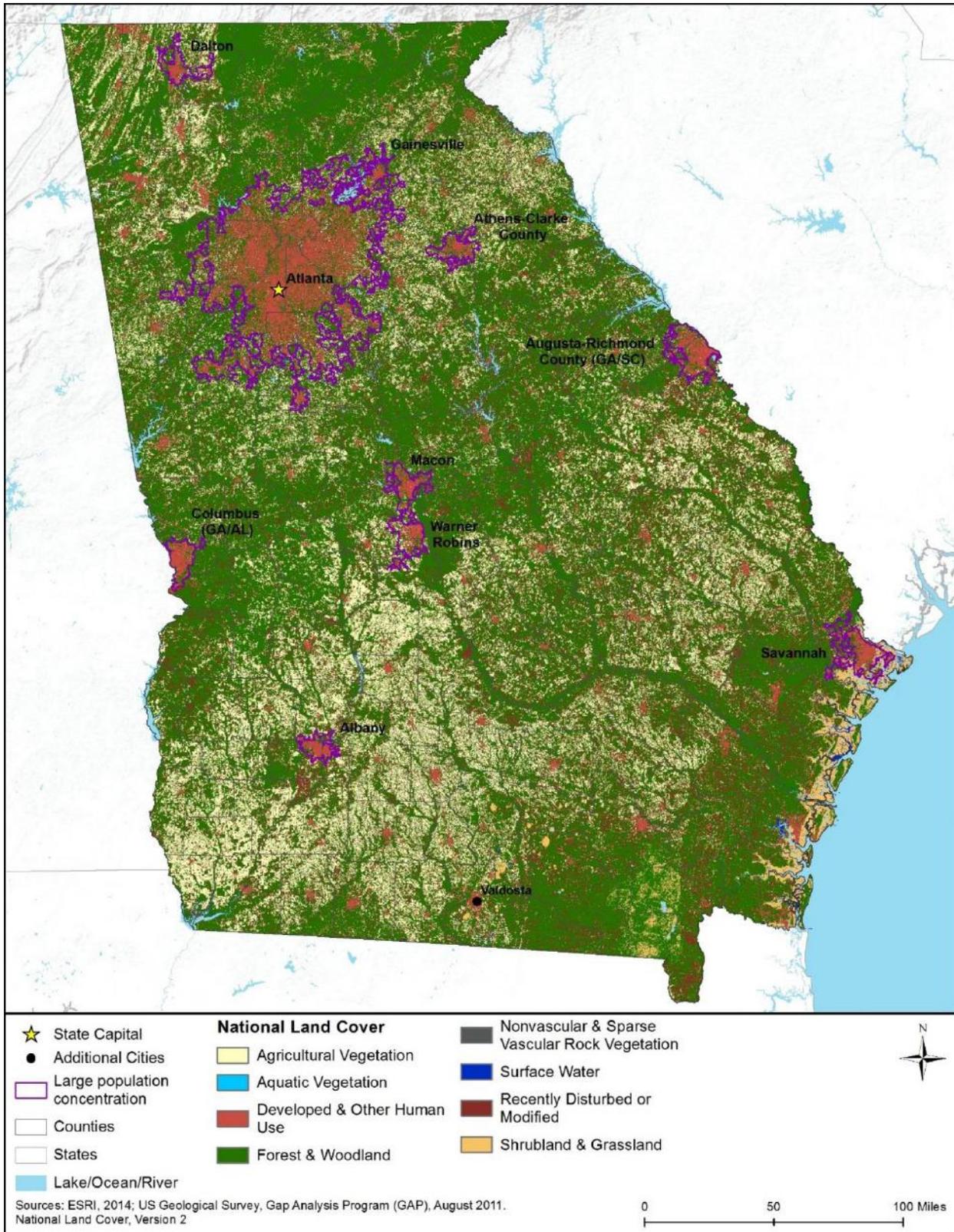
Source: (U.S. Census Bureau, 2015e)

<sup>a</sup> The population estimate for 2016 was 10,310,371. (U.S. Census Bureau, 2017)

### **Land Ownership**

Land ownership within Georgia has been classified into three main categories: private, federal, and state (Figure 6.1.7-1).<sup>113</sup>

<sup>113</sup> Land ownership data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show Owner and used USGS’ PAD-US ownership symbolization for consistency. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.



**Figure 6.1.7-1: Major Land Use Distribution by Coverage Type**

*Private Land*

The majority of land in Georgia is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 6.1.7-1). 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.<sup>114</sup>

*Federal Land*

The federal government manages 1,417 square miles (2.5 percent) of Georgia land with a variety of land types and uses, including NPS units, monuments, historic sites, military bases, and national forests. Table 6.1.7-3 identifies the five federal agencies that manage the majority of federal lands throughout the state (Table 6.1.7-3 and Figure 6.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state. Some federal agencies only have small areas of federal lands scattered through the state. (USGS, 2016c).

- The DoD owns and manages 192.7 square miles used for military bases, forts, and air force bases as well as 10 USACE recreation areas;
- The USFWS owns and manages 160.3 square miles consisting of nine NWRs;
- The USFS owns and manages 492.2 square miles set aside as the Chattahoochee-Oconee National Forest;
- The NPS manages 568.7 square miles including 3 National Historic Sites, 1 National Battlefield Park, 1 National Recreation Area, 1 National Seashore, 1 National Military Park, 3 National Monuments, and portions of 1 National Scenic Trail and 1 National Historic Trail; and
- The TVA manages 2.6 square miles of public land around three reservoirs.

**Table 6.1.7-3: Major Land Ownership Distribution**

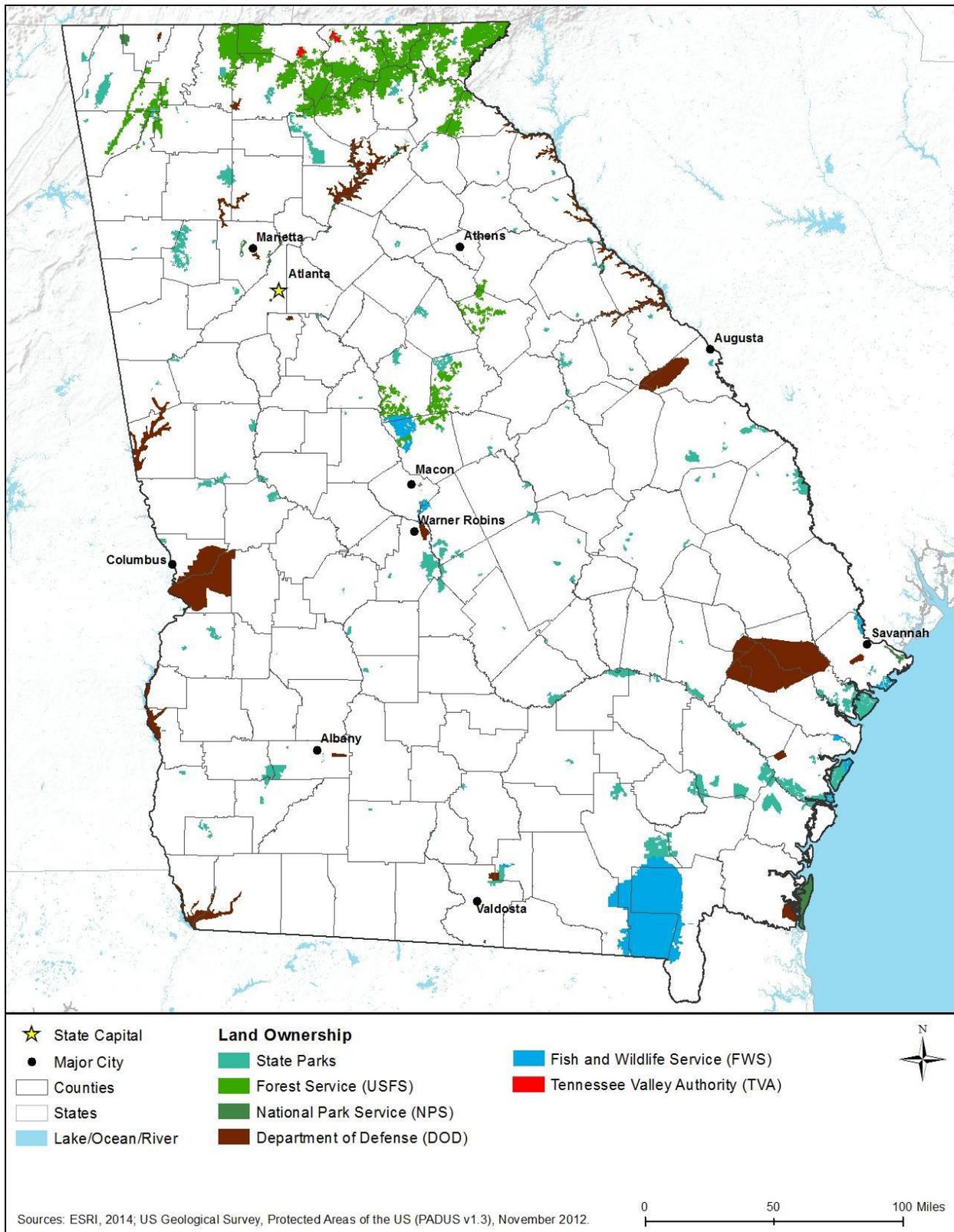
Agency <sup>a</sup>	Square Miles	Representative Type
USFWS	160.3	National Wildlife Refuges
U.S. Forest Service (USFS)	492.2	National Forest
Department of Defense (DoD)	192.7	Military bases, forts, USACE recreation areas
National Park Service (NPS) <sup>b</sup>	568.7	Historic Sites, National Monuments, National Recreation Area, National Seashore, National Battlefield Park, National Military Park, National Scenic Trail, National Historic Trail
Tennessee Valley Authority (TVA)	2.6	Reservoirs
<b>Total</b>	<b>1,416.5</b>	

Source: (USGS, 2016d) (USGS, 2014f) (TVA, 2015)

<sup>a</sup> Table identifies land wholly managed by the Agency; additional properties may be managed by or affiliated with the Agency.

<sup>b</sup> Additional trails and corridors pass through Georgia that are part of the National Park System.

<sup>114</sup> Total acreage of private land could not be obtained for the state.



**Figure 6.1.7-2: Land Ownership Distribution**

*State Land*<sup>115</sup>

The Georgia state government owns approximately 665.4 square miles of land comprised of forests and woodlands, historic sites, state offices, and recreation areas.

**Table 6.1.7-4: State Land in Georgia**

<b>Agency</b>	<b>Square Miles<sup>a</sup></b>	<b>Representative Type</b>
GADNR	100	State parks and historic sites
Georgia Forestry Commission	100	State forests
Division of Wildlife Resources	156	Wildlife Management Areas
Other	309	

Source: (GADNR, 2015o)

<sup>a</sup> Acres are not additive due to overlapping boundaries of the State Forests, State Parks and Recreation Areas, and Wildlife Management Areas.

GADNR manages 63 state parks and historic sites totaling over 100 square miles of forest, lakes, streams, and historic buildings and sites. State WMAs are lands owned by Georgia (156 square miles) that were acquired primarily for the production and use of wildlife, including research on wildlife species and habitat management. WMAs are managed by the Division of Wildlife Resources.

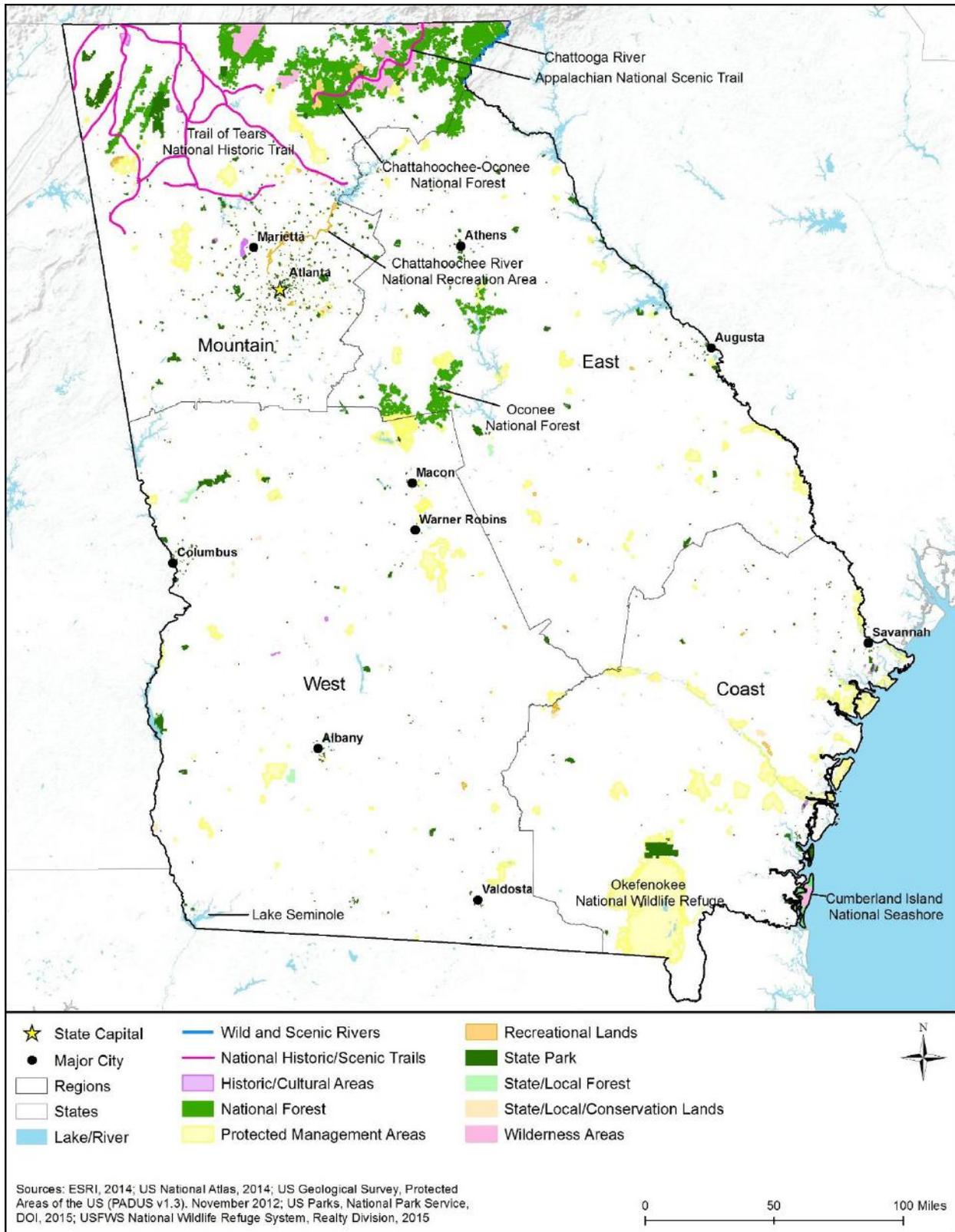
**6.1.7.4. Recreation**

Georgia is geographically diverse, with the Appalachian Mountains in the north, the Piedmont and mountain foothills in the central part of the state, wetlands to the south, and Atlantic coast on the east. Accordingly, recreational activities in the state vary from hiking and trail use, wildlife viewing and fishing, to beach combing. On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, indoor and outdoor pools, and dog runs. Availability of community-level facilities is typically commensurate to the population’s needs.

This section discusses recreational opportunities available at various locations throughout Georgia. For information on visual resources, see Section 6.1.8, Visual Resources, and for information on the historical significance of locations, see Section 6.1.11, Cultural Resources.

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<sup>115</sup> 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.



**Figure 6.1.7-3: Georgia Recreation Resources**

## Mountain Region

Georgia's Mountain Region is bordered by Tennessee and North Carolina to the north, the Chattooga River and the Francis and Marion National Forests in South Carolina to the east, and Alabama to the west (see Figure 6.1.7-3).<sup>116</sup> The region contains the southern edge of the Blue Ridge Mountains and the Piedmont, giving the region its name.

The Chattahoochee National Forest is located in the Mountain Region, containing Track Rock Gap Petroglyph Site, Anna Ruby Falls Recreation Area, and the Brasstown Bald Visitor's Center. Recreational activities include hiking, bicycling, horseback riding, geocaching, and other trail use; gold panning and mineral collection; camping and picnicking; lake and river fishing, boating, swimming, waterskiing, and other water activities; and licensed, seasonal hunting. The last 79 miles of the Appalachian Trail are in the Chattahoochee National Forest with a difficulty rating varying from easy to challenging (Appalachian Trail Conservancy, 2015). The Chattahoochee River National Recreational Area is located along 48 miles of the river, and is known for fishing, boating, and trail use. (USFS, 2015a)

Atlanta is the tourism hub for the state of Georgia, with a variety of different activities. The Centennial Olympic Park is a legacy of when the city hosted the 1996 Summer Olympic Games, and is visited annually by approximately 3 million visitors. Museums in Atlanta include the Delta Flight Museum, the Fernbank Museum of Natural History, the World of Coca-Cola, and the Georgia Aquarium. (Atlanta Convention and Visitor's Bureau, 2015)

## Eastern Region

The Eastern Region is characterized by the Piedmont Plateau, and is bordered to the east by the Savannah River and South Carolina (see Figure 6.1.7-3).

The Oconee National Forest lies along the Oconee River and is managed with the Chattahoochee National Forest. Recreational activities include hiking, bicycling, horseback riding, geocaching, and other trail use; gold panning and mineral collection; camping and picnicking; lake and river fishing, boating, swimming, waterskiing, and other water activities; and licensed, seasonal hunting. (USFS, 2015a)

The Eastern Region is home to several state parks. The Magnolia Springs State Park is visited for its natural spring and boardwalk; activities include hiking, bicycling, geocaching, and other trail use; camping and picnicking; and fishing in the springs (GADNR, 2015p). The Hamburg State Outdoor Recreation Area is known for fishing and wildlife viewing, other activities include boating, camping and picnicking, geocaching, hiking and other trail use (GADNR, 2015q). The Richard B. Russell State Park, Bobby Brown Park, Elijah Clark State Park, and other state parks

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<sup>116</sup> Recreational area data was retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried to show the Primary Designation Type of area. To show these in the map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for recreational resources. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

are located along the Savannah River and its lakes; these parks are known for activities including hiking, geocaching, and other trail use; golf, mini-golf, and Frisbee golf courses; camping and picnicking; fishing, boating, swimming, waterskiing, and other water activities; and licensed, seasonal hunting (GADNR, 2015r) (GADNR, 2015s) (GADNR, 2015t).

### **Western Region**

Western Georgia catches the very southern tip of the Piedmont plateau, and begins the swampy areas that flow into Florida (see Figure 6.1.7-3).

Lake Seminole is a hub for recreation in the Western Region. The lake is shared with Florida, and recreational areas surround the lake. The Seminole State Park, on the northern shore, has hiking, birdwatching, geocaching, and other trail use; miniature golf; camping and picnicking; and fishing, boating, waterskiing, and other water activities (GADNR, 2015u). Silver Lake Wildlife Management Area has hiking, birdwatching, and other trail use; fishing and other water activities; and licensed, seasonal hunting (GADED, 2015).

### **Coastal Region**

Georgia's Coastal Region is bordered by the Atlantic Ocean to the east, and is characterized as the lower coastal plain (see Figure 6.1.7-3). The region is known for barrier islands and interior wetlands.

The Okefenokee National Wildlife Refuge has open prairies and forest cypress swamps famous for its wildlife; within the refuge are the Stephen C. Foster State Park and the Okefenokee Swamp Park. Activities available include hiking, wildlife viewing, and other trail use; camping; fishing, canoeing, boating, and other water activities; and licensed, seasonal hunting. (USFWS, 2015ci)

Recreational areas are located along Georgia's barrier islands. The Savannah Coastal Refuges Complex includes four refuges in the state: Wassaw, Harris Neck, Blackbeard Island, and Wolf Island National Wildlife Refuges. Recreation within the refuges include hiking, wildlife viewing, and other trail use; camping; fishing, canoeing, boating, and other water activities; and licensed, seasonal hunting (USFWS, 2015cj).

The Cumberland Island National Seashore is accessible by ferry, and includes beaches and historic sites such as the Dungeness Ruins and the Plum Orchard Mansion. Activities within the seashore include hiking, birdwatching, wildlife viewing, and other trail use; camping; fishing, boating, swimming, beach combing, and other water activities; and licensed, seasonal hunting. (NPS, 2015c)

#### **6.1.7.5. 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 6.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)<sup>117</sup> service is based on the airspace classification (FAA, 2008).



Source: Derived from (FAA, 2008)

**Figure 6.1.7-4: National Air Space Classification Profile**

### *Controlled Airspace*

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).<sup>118</sup> 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).<sup>119</sup>

<sup>117</sup> ATC – Approved authority service to provide safe, orderly, and expeditious flow of air traffic operations (FAA, 2015c).

<sup>118</sup> 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).

<sup>119</sup> 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 6.1.7-5).

**Table 6.1.7-5: 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.”

SUA Type	Definition
MOAs	“Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic.”
Alert Areas	“Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance.”
Controlled Firing Areas (CFAs)	“Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path.”
National Security Areas (NSA)	“Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 99.7. Regulatory prohibitions are issued by System Operations, System Operations Airspace and Aeronautical Information Manual (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 6.1.7-6, 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 6.1.7-6: Other Airspace Designations**

Type	Definition
Airport Advisory	There are three types: <ul style="list-style-type: none"> <li>• Local Airport Advisory – Operated within 10 statute (5,280 feet/mile) 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.</li> <li>• Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower.</li> <li>• Remote Airport Information Service – Used for short-term special events.</li> </ul>
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: <ul style="list-style-type: none"> <li>• Protect people and property from a hazard;</li> <li>• Provide safety for disaster relief aircraft during operations;</li> <li>• Avoid unsafe aircraft congestion associated with an incident or public interest event;</li> <li>• Protect the U.S. President, Vice President, and other public figures;</li> </ul>

Type	Definition
	<ul style="list-style-type: none"> <li>• Provide safety for space operations; and</li> <li>• Protect in the State of Hawaii declared national disasters for humanitarian reasons.</li> </ul> Only those TFRs annotated with an ending date and time of “permanent” are included in this Final PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

Source: (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 and 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. above ground 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.

## Georgia Airspace

The Georgia Aeronautics Program is a component of GADOT, who promotes the use of state aviation facilities and viable scheduled air service, and maintains public-use airports and aviation safety. Within these responsibilities are two functions – airport development and aviation planning (GADOT, 2015d). Under the provisions of Article 1 of Chapter 3, Powers of Local Governments as to Air Facilities (O.C.G.A. § 6-3-1), GADOT is responsible for construction and maintenance of airports, landing fields, air navigation facilities, and lighting and lighting fixtures (Georgia General Assembly, 2015). Pursuant to Georgia aviation statutes, Title 6 Aviation, Chapter 5 Georgia Aviation Authority, the authority’s purpose is “acquire, operate, maintain, house, and dispose of all state aviation assets, to provide aviation services and oversight of state aircraft and aviation operations to ensure the safety of state air travelers and aviation property, to achieve policy objectives through aviation missions, and to provide for the efficient operation of state aircraft” (Georgia General Assembly, 2015) (Georgia Government, 2015). There is one FSDO for Georgia located in Atlanta (FAA, 2016b).

Georgia 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. (NASAO, 2015) Figure 6.1.7-5 presents the different aviation airports/facilities residing in Georgia, while Figure 6.1.7-6 and Figure 6.1.7-7 present the breakout by public and private airports/facilities. There are approximately 456 airports within Georgia as presented in Figure 6.1.7-5 through Figure 6.1.7-7 and Table 6.1.7-7 (USDOT, 2015a).

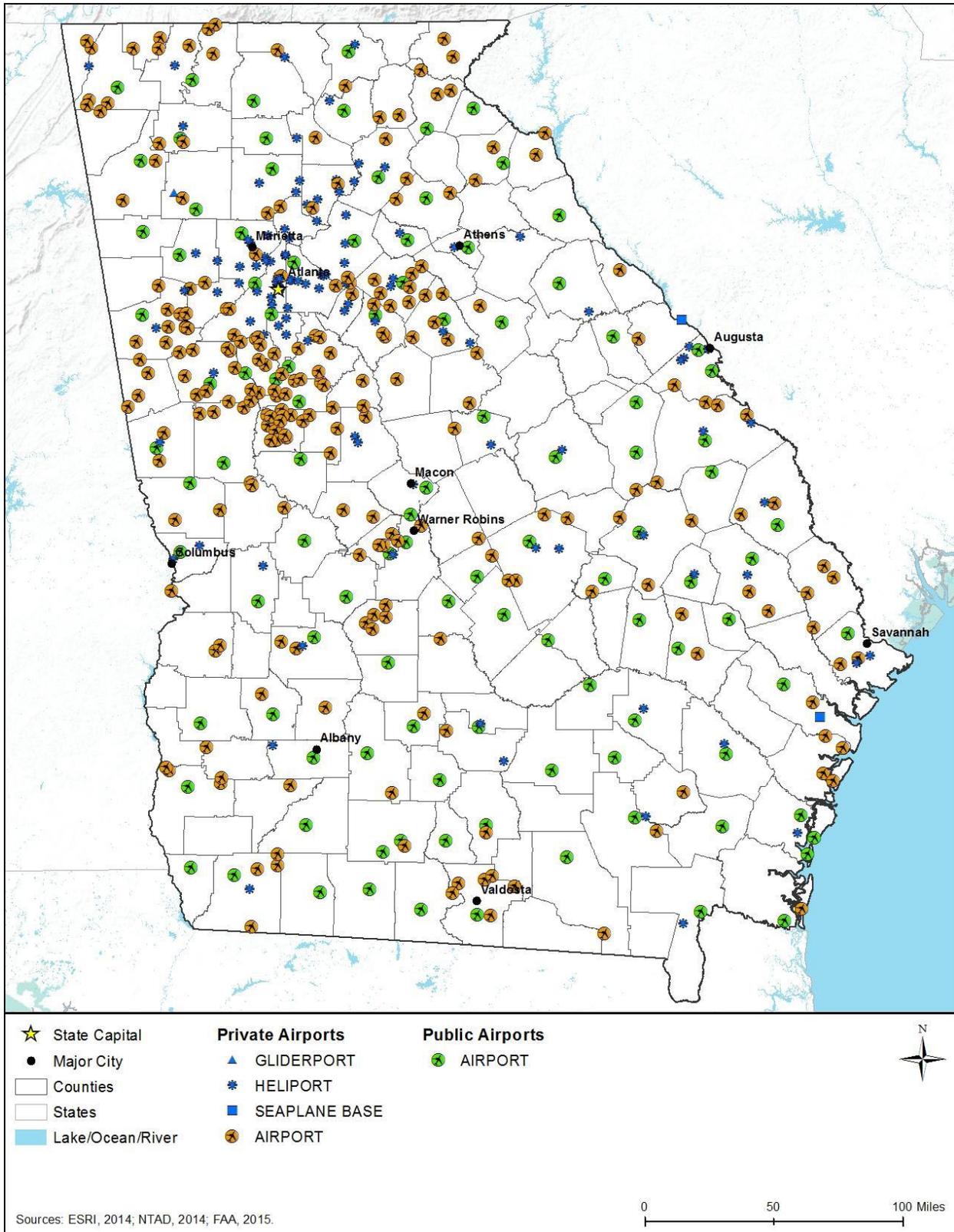
**Table 6.1.7-7: Type and Number of Georgia Airports/Facilities**

Type of Airport or Facility	Public	Private
Airport	107	231
Heliport	0	115
Seaplane	0	2
Ultralight	0	0
Balloonport	0	0
Gliderport	0	1
<b>Total</b>	<b>107</b>	<b>349</b>

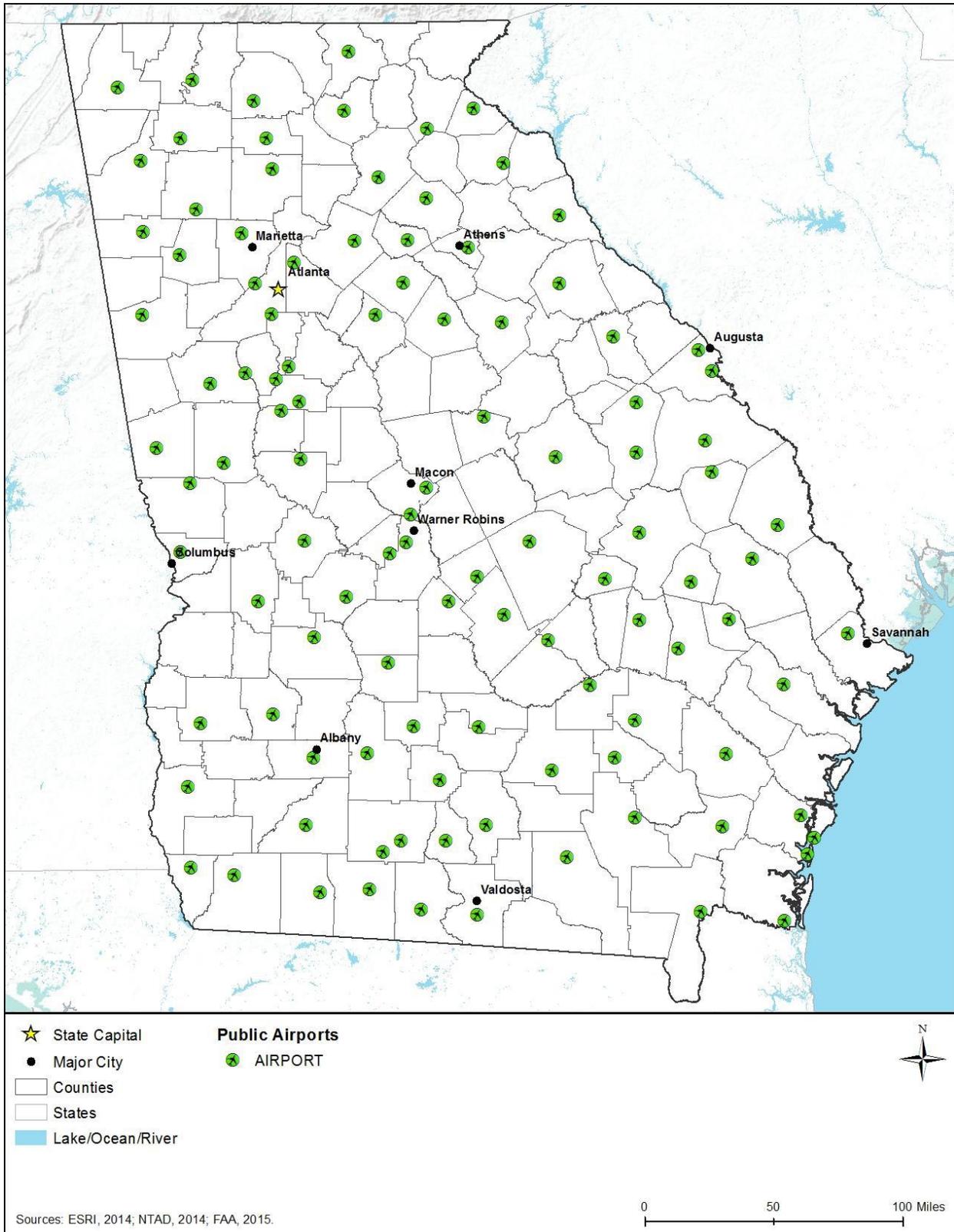
Source: (USDOT, 2015b)

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

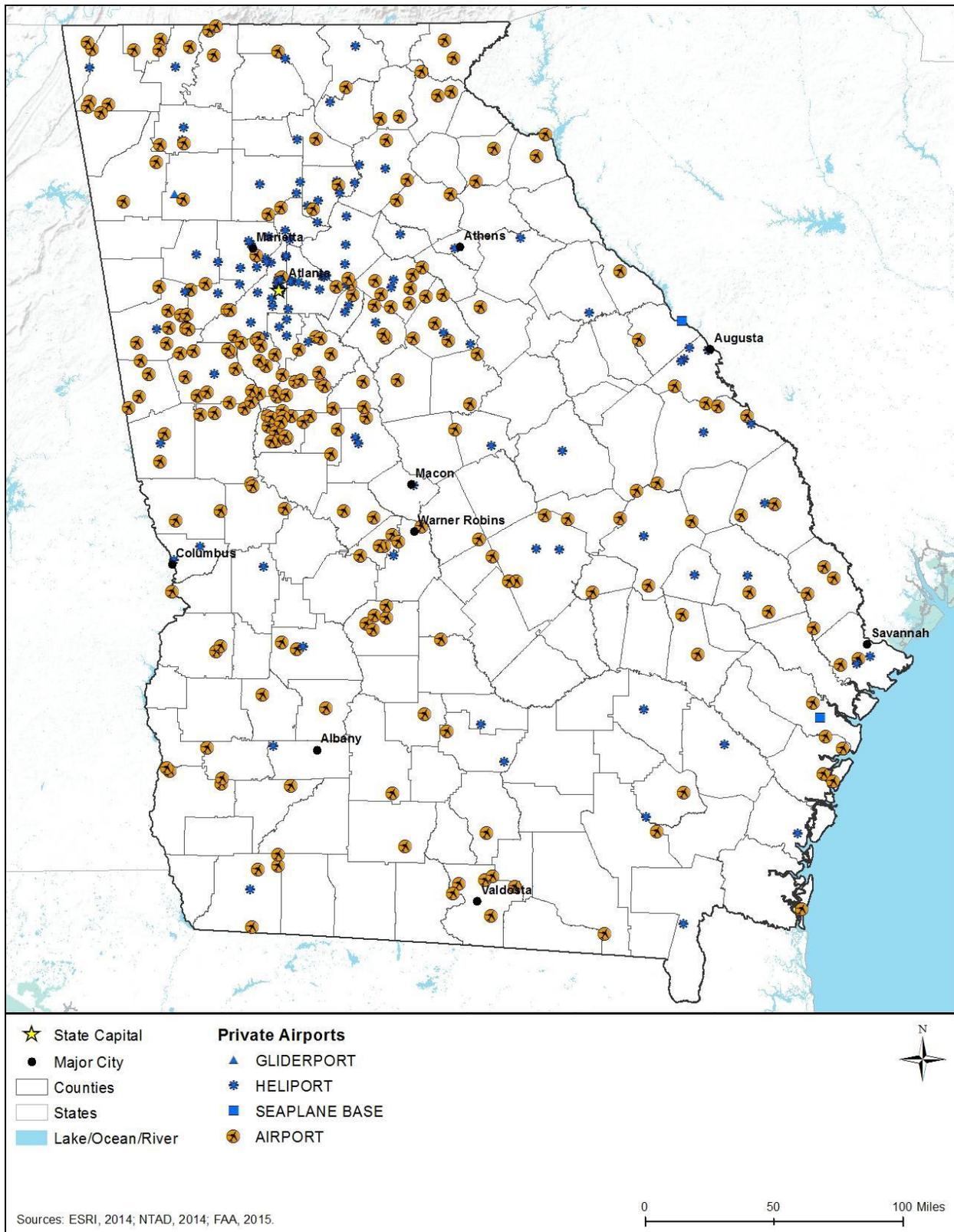
- One Class B –
  - Hartsfield-Jackson Atlanta International, Atlanta
- One Class C –
  - Savannah/Hilton Head International, Savannah
- Seventeen Class D –
  - Southwest Georgia Regional, Albany
  - Athens/Ben Epps, Athens
  - DeKalb-Peachtree, Atlanta
  - Fulton County Airport-Brown Field, Atlanta
  - Augusta Regional At Bush Field, Augusta
  - Columbus Metropolitan, Columbus
  - Columbus Lawson Army Airfield (AAF), Fort Benning (Columbus)
  - Heart of Georgia Regional, Eastman
  - Wright AAF (Fort Stewart)/Midcoast Regional, Hinesville
  - Gwinnett County-Briscoe Field, Lawrenceville
  - Macon, Middle Georgia Regional, Macon
  - Cobb County-McCollum Field, Marietta
  - Dobbins Air Reserve Base (ARB) [Naval Air Station (NAS) Atlanta], Marietta
  - Robins Air Force Base (AFB), Warner Robins
  - Hunter AAF, Savannah
  - Moody AFB, Valdosta
  - Valdosta Regional, Valdosta (FAA, 2015e)



**Figure 6.1.7-5: Composite of Georgia Airports/Facilities**



**Figure 6.1.7-6: Public Georgia Airports/Facilities**



**Figure 6.1.7-7: Private Georgia Airports/Facilities**

SUAs (i.e., one prohibited area, 22 restricted areas, 21 MOAs, and one alert area) located in Georgia are as follows:

- Kings Bay –
  - P-50 – Surface to, but not including, 3,000 feet MSL
- Fort Benning –
  - R-3002A – Surface to 4,000 feet MSL
  - R-3002B – 4,000 feet MSL to 8,000 feet MSL
  - R-3002C – 8,000 feet MSL to 14,000 feet MSL
  - R-3002D – Surface to 8,000 feet MSL
  - R-3002E – 8,000 feet MSL to 14,000 feet MSL
  - R-3002F – 14,000 feet MSL to FL 250
  - R-3002G – Surface to 14,000 feet MSL
- Fort Gordon –
  - R-3004A – Surface to 7,000 feet MSL
  - R-3004B – 7,001 feet MSL to 16,000 feet MSL
- Fort Stewart –
  - R-3005A – Surface to 29,000 feet MSL
  - R-3005B – Surface to 29,000 feet MSL
  - R-3005C – Surface to 29,000 feet MSL
  - R-3005D – Surface to 29,000 feet MSL
  - R-3005E – Surface to 29,000 feet MSL
- Townsend
  - R-3007A – Surface to, but not including, 13,000 feet MSL
  - R-3007B – 1,200 feet above ground level (AGL) to, but not including, 13,000 feet MSL
  - R-3007C – 100 feet AGL to, but not including, 13,000 feet MSL
  - R-3007D – 13,000 feet MSL to FL 250
- Grand Bay Weapons Range –
  - R-3008A – Surface to 10,000 feet MSL
  - R-3008B – 100 feet AGL to 10,000 feet MSL
  - R-3008C – 500 feet AGL to 10,000 feet MSL; excluding that airspace below 1,500 feet AGL within one NM radius of Lakeland, GA centered at lat. 31°02'31"N., long. 83°04'15"W
  - R-3008D – 10,000 feet MSL to, but not including, FL 230 (FAA, 2015e)

The twenty-one MOAs for Georgia and one alert area are as follows:

- Benning –
  - 500 feet AGL to and including 8,000 feet MSL
- Bulldog –
  - A – 500 feet AGL to, but not including, 10,000 feet MSL
  - B – 10,000 feet MSL up to, but not including, FL 180
  - C – 500 feet AGL to, but not including, 10,000 feet MSL
  - D – 500 feet AGL to and including 17,000 feet MSL; Excluding the area described as beginning: at lat. 33°17'37"N., long. 82°24'25"W.; to lat. 33°15'54"N., long.

82°20'50"W.; thence clockwise via a three-NM arc centered at lat. 33°13'21"N., long. 82°22'44"W.; to lat. 33°12'17"N., long. 82°19'23"W.; to lat. 33°12'01"N., long. 82°22'59"W.; to lat. 33°14'01"N., long. 82°29'59"W.; to the point of beginning, 1,500 feet AGL and below

- E – 5,000 feet MSL to, but not including, 10,000 feet MSL
- Coastal –
  - 1 east – 300 feet AGL to, but not including, FL 180
  - 2 – 300 feet AGL to, but not including, FL 180
  - 4 – 14,000 feet MSL to, but not including, FL 180
  - 5 – 300 feet AGL to, but not including, FL 180
  - 6 – 10,001 feet MSL to, but not including, FL 180
  - 7 – 10,001 feet MSL to, but not including, FL 180
  - 8 – 11,000 feet MSL to, but not including, FL 180
- Fort Stewart –
  - B1 – 500 feet AGL to 4,999 feet MSL
  - B2 – 5,000 feet MSL to 10,000 feet MSL
  - C1 – 500 feet AGL to 2,999 feet MSL
  - C2 – 3,000 feet MSL to 10,000 feet MSL
- Moody –
  - 1 – 8,000 feet MSL to, but not including, FL 180
  - 2 north – 500 feet AGL to, but not including, 8,000 feet MSL
  - 2 south – 100 feet AGL to, but not including, 8,000 feet MSL
  - 3 – 8,000 feet MSL to but not including FL 180
- Dahunega –
  - A-685 – Surface to 700 feet AGL (FAA, 2015f)

A-211 (from the surface to and including 5,000 feet) of Alabama just extends into the southwestern portion of Georgia (west of Albany). The SUAs for Georgia are presented in Figure 6.1.7-8; there are no TFRs (FAA, 2015g). MTRs in Georgia, presented in Figure 6.1.7-9, consist of twenty Visual Routes, eleven Instrument Routes, and eight Slow Routes.

### *UAS Considerations*

The NPS signed a policy memorandum on June 20, 2014 that “directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the [NPS]” (NPS, 2014a). There are 11 NPS units within the state of Georgia that has to comply with this agency directive (NPS, 2015d).

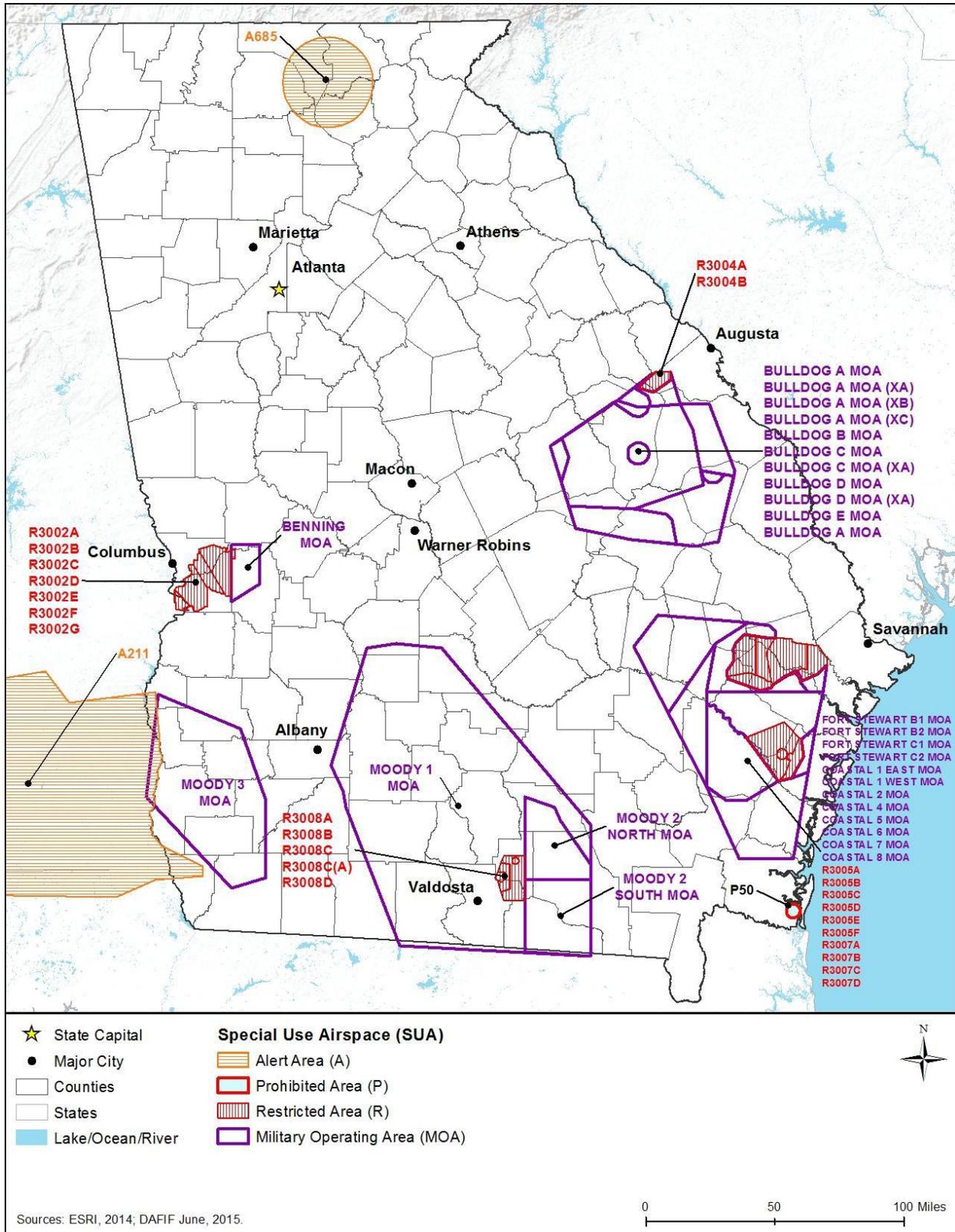
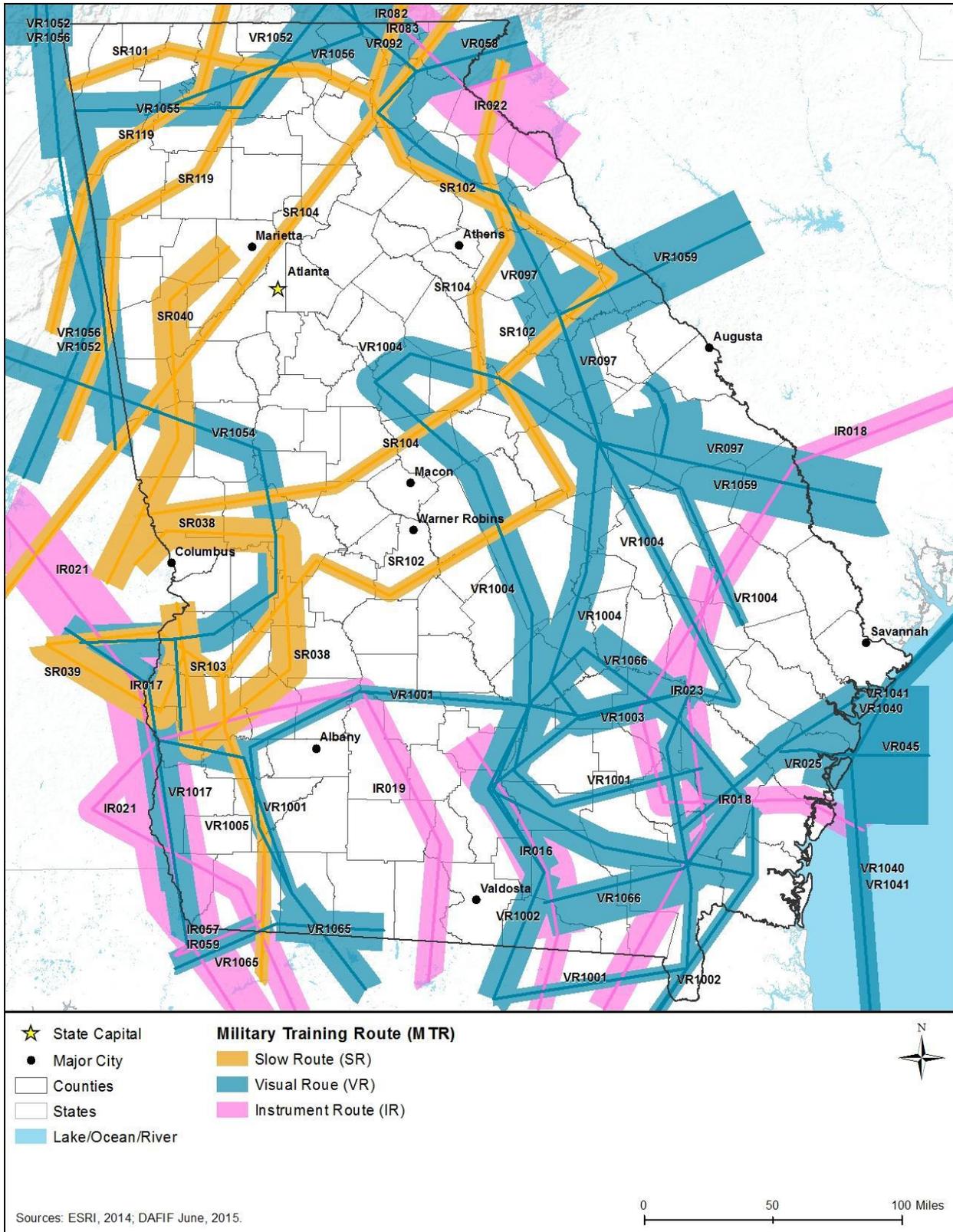


Figure 6.1.7-8: SUAs in Georgia



**Figure 6.1.7-9: MTRs in Georgia**

## 6.1.8. Visual Resources

### 6.1.8.1. 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 the Proposed Action for NEPA and National Historic Preservation Act (NHPA) compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management (BLM), “the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)” (BLM, 1984).

### 6.1.8.2. Specific Regulatory Considerations

Table 6.1.8-1 presents state and local laws and regulations that relate to visual resources.

**Table 6.1.8-1: Relevant Georgia Visual Resources Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
State Historic Preservation Office (1986); 12-3-50.1	Historic Preservation Division (HPD)	Establishes historic preservation as public policy and authorizes the HPD of the GADNR to carry out a statewide historic preservation program, similar to those duties outlined in the National Historic Preservation Act.
Georgia Historic Preservation Act (1980, 1989); 44-10-20 et seq.	HPD	Establishes uniform guidelines for local governments in creating historic preservation commissions and designating historic properties.
Georgia Land Conservation Act (2005); 36-22-1 et seq.	GADNR	Provides a comprehensive program of funding and tax incentives to protect a broad range of natural and historic properties through land acquisition and/or conservation easements.
Georgia Environmental Policy Act (1991) 12-16-1 et seq.	GADNR	Requires state agencies to prepare environmental assessments on actions that impact the environment, including historic properties.

Source: (GADNR, 2017c)

There are several programs managed by GADNR to preserve the natural, environmental, historic, and recreational resources of Georgia, including the Georgia Coastal Management Program, State Comprehensive Outdoor Recreation Plan, and the State Wildlife Action Plan. In addition to the state laws and regulations, local jurisdictions in Georgia have the authority to designate and prevent destruction of historic and cultural resources, which contain important visual resources through Georgia’s Certified Local Government Program. Additionally, local jurisdictions in Georgia determine zoning laws and regulations for development, which may or may not restrict impacts to the state’s visual resources.

### **6.1.8.3. Character and Visual Quality of the Existing Landscape**

Georgia has a wide range of visual resources. The state is home to a diverse landscape including mountains, swamps, marshlands, coastal plains, and lakes. The highest elevations in Georgia are in the northwest corner at the southern edges of the Appalachian Mountains, which then slopes gradually to the southeast to the coastal plains. The state's highest point is Brasstown Bald at 4,784 feet in the Blue Ridge Mountains of the Appalachians. Major rivers in Georgia include the Chattahoochee, Flint, Ocmulgee, and Savannah. In addition, the state contains many manmade lakes and reservoirs. In the south portion of Georgia are several swampy areas, with the largest one being the Okefenokee Swamp, as well as rolling red-clay hills of the Piedmont Plateau. The Atlantic Coastal plain lowlands of Georgia are bordered by several sea islands, including Cumberland, Jekyll, and Little St. Simon Islands. (USGS, 2017) (USGS, 2001b)

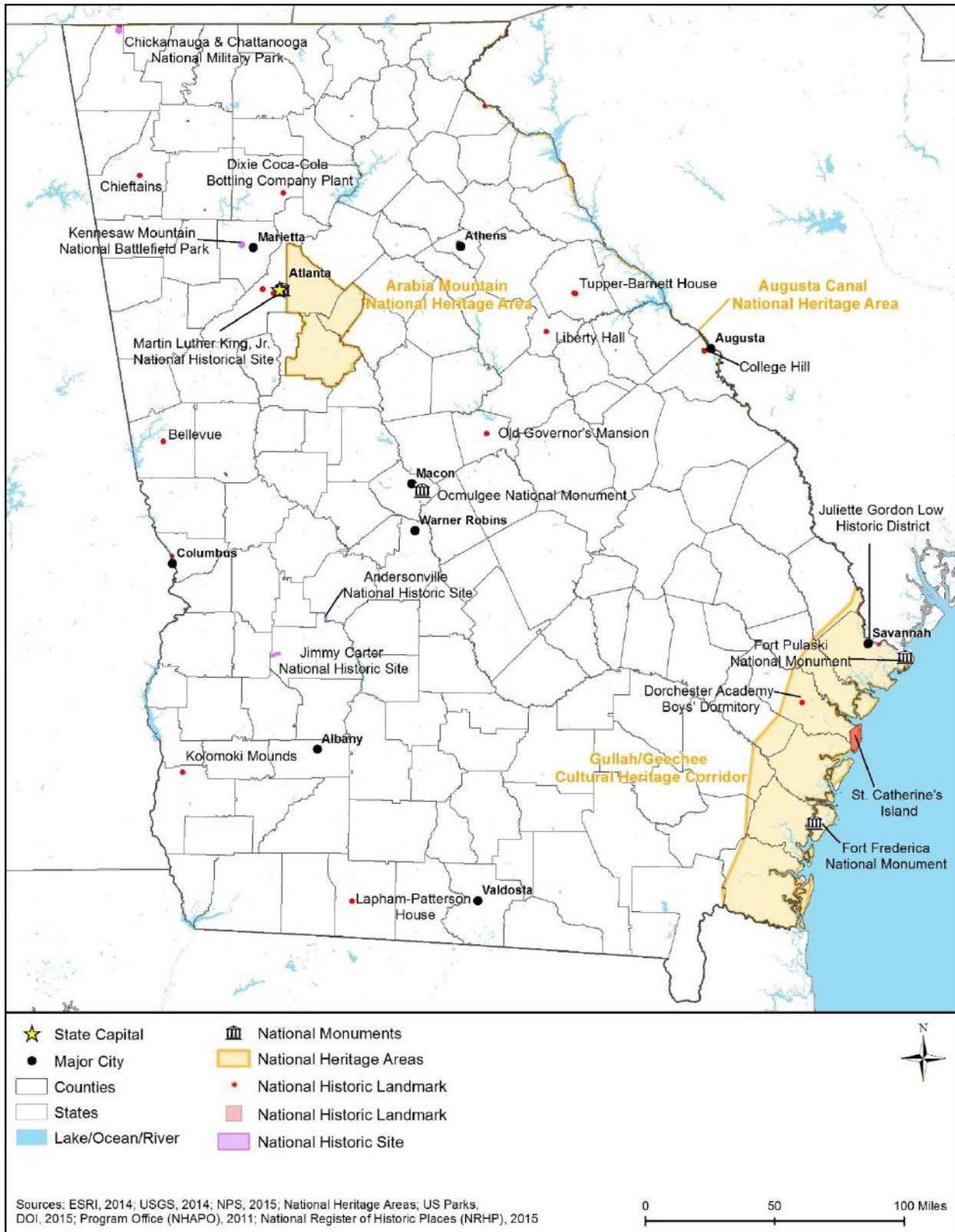
More than half of Georgia is characterized as forested areas (Figure 6.1.7-1 in Section 6.1.7, Land Use, Recreation, and Airspace) (USDA, 2015c). Forested areas generally have continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape. Croplands are the second most dominant landscape in the state, which generally contain similar visual resources as forested areas. While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

### **6.1.8.4. 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 6.1.8-1 shows a sampling of areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Georgia, there are 2,105 NRHP listed sites, which include 49 National Historic Landmarks, 2 National Battlefields, 3 National Historic Sites, and 3 National Monuments (NPS, 2015e). 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. 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)



**Figure 6.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive**

## **National Heritage Areas**

National Heritage Areas (NHAs) are “places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape” (NPS, 2011a). These areas help tell the history of the United States. Based on this criteria, NHAs in Georgia may contain scenic or aesthetic areas considered visual resources or visually sensitive. There are three NHAs in Georgia: Arabia Mountain National Heritage Area, Gullah/Geechee Cultural Heritage Corridor, and Augusta Canal National Heritage Area (Figure 6.1.8-1). Arabia Mountain has locations that highlight “the history of granite mining as an industry and culture in Georgia,” as well as active quarries, and pine and oak forests (NPS, 2015f). The Gullah/Geechee Cultural Heritage Corridor extends from Wilmington, North Carolina to St. Augustine, Florida and encompasses the areas of the southeast where descendants of west and central African slaves amalgamated their African traditions with American culture (NPS, 2015g). The Augusta Canal National Heritage Area is a nine-mile corridor containing an industrial canal from 1845 still in use today for water power, transportation, and water supply (NPS, 2015f).

## **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, 2015h). NHLs may include “historic buildings, sites, structures, objects, and districts” (NPS, 2016a). 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 Georgia, there are 49 NHLs, including sites such as the Dixie Coca-Cola Bottling Company Plant, Martin Luther King, Jr. Historic District, Juliette Gordon Low Historic District, Tupper-Barnett House, and Dorchester Academy Boys’ Dormitory (Figure 6.1.8-1) (NPS, 2015i). By comparison, there are over 2,500 NHLs in the United States, less than 2 percent of these located in Georgia (NPS, 2015j). Figure 6.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

## **National Battlefields**

The general title national battlefield includes national battlefield, national battlefield park, national battlefield site, and national military park. Georgia has one national battlefield park and one national military park, which are areas associated with American military history (NPS, 2003). Kennesaw Mountain National Battlefield Park is “a 2,965 acre National Battlefield that preserves a Civil War battleground of the Atlanta Campaign” in 1864 (NPS, 2015e). Chickamauga and Chattanooga National Military Park is the site of both Confederate and Union victories for the control of Chattanooga in 1863 (NPS, 2015e). These sites may contain aesthetic and scenic values associated with history and are identified on the map in Figure 6.1.8-1.

### National Historic Sites and Historical Parks

Georgia has three National Historic Sites and Historical Parks, which are preserved by the NPS to “commemorate persons, events, and activities important in the nation’s history” (NPS, 2003). Parks are generally larger in size and complexity than sites (NPS, 2003). The three national historic sites (NHSs) in Georgia are Andersonville NHS, Jimmy Carter NHS, and Martin Luther King, Jr. NHS. Andersonville NHS was once the site of the Camp Sumter military prison during the Civil War, but now stands as a “memorial to all American prisoners of war throughout the nation’s history” (NPS, 2015e). The Jimmy Carter and Martin Luther King, Jr. NHS both mark where these important historic figures were born and raised (NPS, 2015e). These sites may contain aesthetic and scenic values associated with history and are identified on the map in Figure 6.1.8-1.

### National Monuments

Georgia has three National Monuments, which are “intended to preserve at least one nationally significant resource” (NPS, 2003). A national monument is usually smaller than a national park and lacks its diversity of attractions (NPS, 2003). The three national monuments in Georgia are Fort Frederica, Fort Pulaski, and Ocmulgee. Fort Frederica marks where British troops defeated Spanish forces in 1742, while Fort Pulaski is the site of a landmark Confederate defeat in the Civil War. Ocmulgee National Monument is a prehistoric American Indian site where different cultures have occupied this land for thousands of years (NPS, 2015e). These sites may contain aesthetic and scenic values associated with history and are identified on the map in Figure 6.1.8-1.

### State Historic Sites, Resources, and Parks

GADNR maintains 19 historic sites and historic parks under its purview, including unique homes, plantations, and Civil War and American Indian sites. These sites may contain aesthetic and scenic values associated with history and are identified in Table 6.1.8-2 and Figure 6.1.8-1 (GADNR, 2015v).

**Table 6.1.8-2: Georgia State Historic Sites**

State Historic Site and Historic Park Name	
A.H. Stephens State Park	Jefferson Davis Memorial Historic Site
Chief Vann House Historic Site	Kolomoki Mounds State Park
Dahlonega Gold Museum Historic Site	Lapham-Patterson House Historic Site
Etowah Indian Mounds Historic Site	Little White House Historic Site
Fort King George Historic Site	New Echota Historic Site
Fort McAllister State Park	Pickett’s Mill Battlefield Historic Site
Fort Morris Historic Site	Robert Toombs House Historic Site
Hardman Farm Historic Site	Traveler’s Rest Historic Site
Hofwyl-Broadfield Plantation Historic Site	Wormsloe Historic Site
Jarrell Plantation Historic Site	

Source: (GADNR, 2015v)

**6.1.8.5. Parks and Recreation Areas**

Parks and recreation areas include state parks, National Recreation Areas, National Seashores, National Forests, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 6.1.7-1 in Section 6.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources that may be visually sensitive in Georgia.

**State Parks**

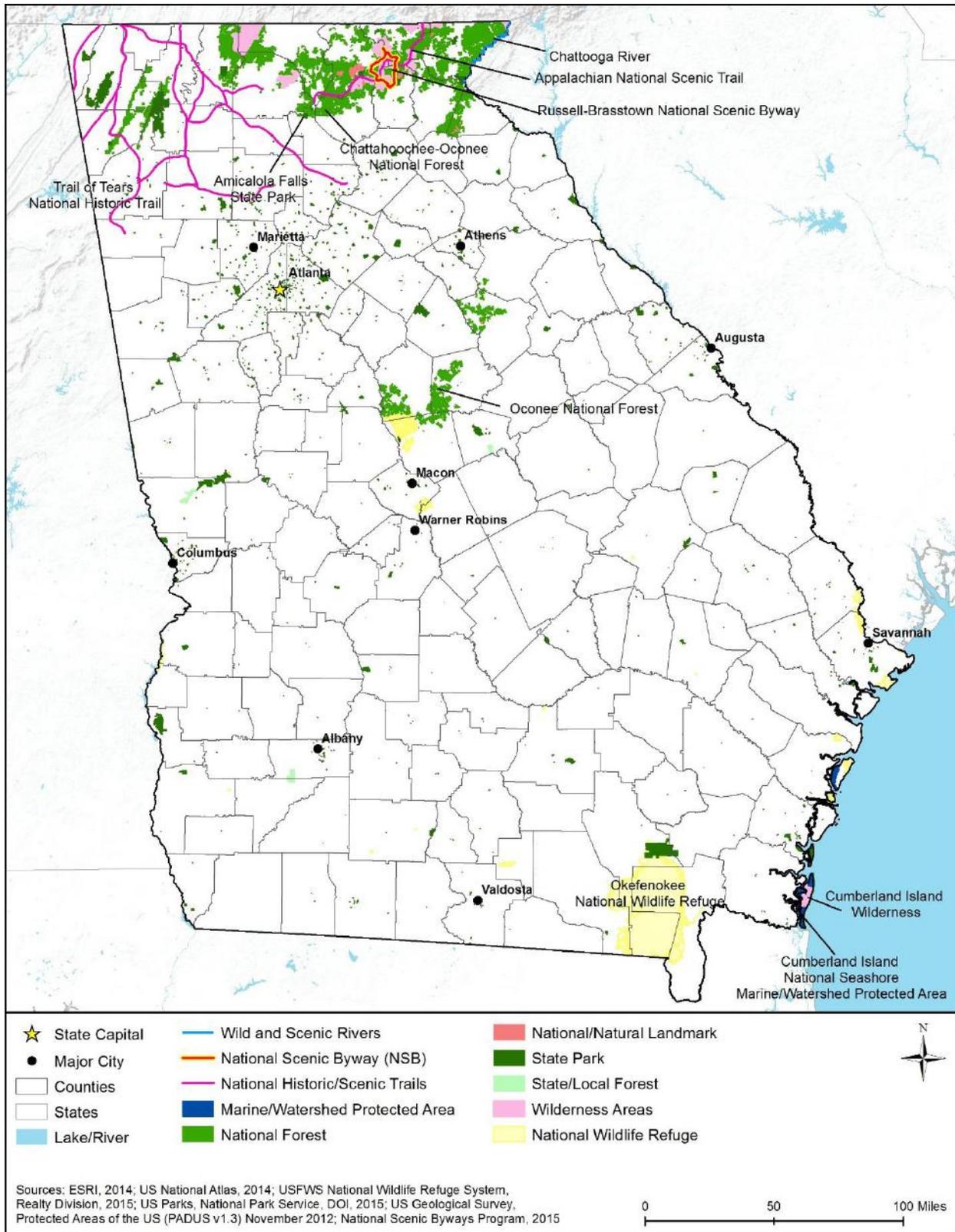
State parks contain natural, historic, cultural, and/or recreational resources of significance to Georgia residents and visitors. There are nearly 50 state parks and outdoor recreation areas throughout Georgia (Figure 6.1.8-2), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (GADNR, 2015w).<sup>120</sup> Table 6.1.8-3 contains a sampling of state parks and their associated visual attributes.

**Table 6.1.8-3: Examples of Georgia State Parks and Associated Visual Attributes**

State Park	Visual Attributes
Amicalola Falls State Park	Waterfall and mountain vistas, wildlife, Appalachian Trail
Crooked River State Park	Intracoastal waterway, maritime forest, palmettos, Spanish moss-draped oaks, tidal river, native coastal wildlife, views of Cumberland Island National Seashore
F. D. Roosevelt State Park	9,049 acres, 40 miles of trails (including 23-mile Pine Mountain Trail), hardwood and pines, creeks, small waterfalls, rolling mountains, King’s Gap, Dowdell’s Knob, fishing lake, warm springs
Red Top Mountain State Park	12,000-acre Lake Allatoona vistas, sandy beach, 15 miles of trails, forested parks, paved trail, gravel-topped 4-mile Iron Hill Trail, rich red soils caused by high iron-ore content
Tallulah Gorge State Park	Tallulah Gorge vistas (two miles long and nearly 1,000 feet deep), suspension bridge, views of the river and waterfalls, paved path following an on old railroad bed, 10-mile trail, Victorian resort town, monkey-face orchid, and green salamander

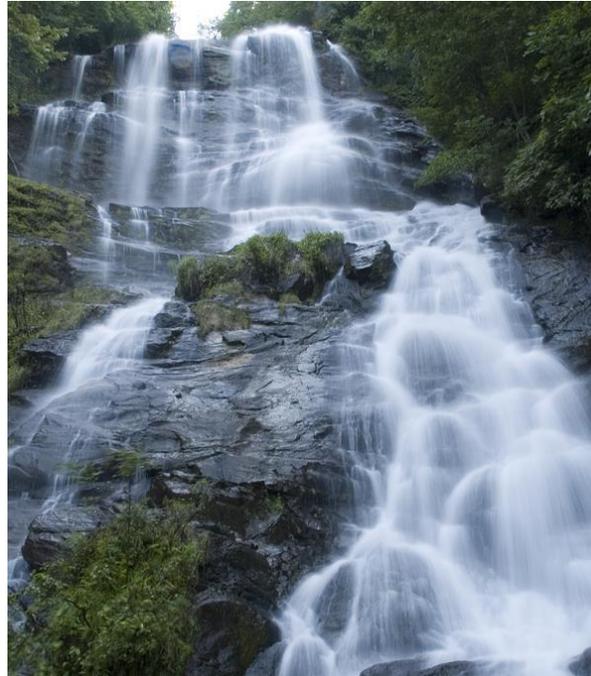
Source: (GADNR, 2015w)

<sup>120</sup> The natural areas data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset that contains large quantities of information relevant to the Proposed Action. The data was queried and further combined by the Primary Designation Type into classifications that fit the multiple types of land applicable for Natural Areas. For this map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for natural areas. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.



**Figure 6.1.8-2: Natural Areas that May be Visually Sensitive**

Amicalola Falls State Park (Figure 6.1.8-3) is one of Georgia’s most popular state parks with the “tallest cascading waterfall in the Southeast” at 729 feet (GADNR, 2015x). The southern end of the Appalachian Trail can also be found by taking an 8.5-mile trail from the park to Spring Mountain.



Source: (GADNR, 2015y)

**Figure 6.1.8-3: Amicalola Falls State Park**

**State Forests**

The Georgia Forestry Commission manages eight state forests throughout the state “under a multiple-use Forest Stewardship management plan taking into account the various wood product, wildlife, recreational, soil, water, aesthetic, historical, and cultural resources of the area” (GFC, 2005b). These forests cover over 63,000 acres and are identified in Table 6.1.8-4 and Figure 6.1.8-2.

**Table 6.1.8-4: Georgia State Forests**

State Forest Name	Acres
Bartram Forest	2,113
Brender-Hitchiti Forest	4,734
Broxton Rocks Forest	350
Dawson Forest	10,130
Dixon Memorial State Forest	35,000
Hightower Forest	142
Paulding Forest	10,000
Spirit Creek Forest	725

Source: (GFC, 2005b)

### National Park Service

National Parks are managed by NPS, contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation, and are maintained for the public’s use. In the Georgia, there are 11<sup>121</sup> officially designated NPS units in addition to other NPS affiliated areas, such as National Heritage Areas. In Georgia, there are two National Battlefields (one National Battlefield Park and one National Military Park), three National Historic Sites, three National Monuments, one National Historic Trail, one National Scenic Trail, one National Recreation Area, one National Seashore, and three National Heritage Areas (NPS, 2015e). Figure 6.1.8-1 and Figure 6.1.8-2 identify the NPS units and affiliated areas located in Georgia. Cumberland Island National Seashore contains maritime forests, beaches, and wide marshes on Georgia’s largest and southernmost barrier island, with 9,800 acres of designated Wilderness (NPS, 2015e).

**Table 6.1.8-5: Georgia National Park Service Units and Affiliated Areas**

Area Name	
Andersonville National Historic Site	Fort Pulaski National Monument
Appalachian National Scenic Trail	Gullah/Geechee Cultural Heritage Corridor
Arabia Mountain National Heritage Area	Jimmy Carter National Historic Site
Augusta Canal National Heritage Area	Kennesaw Mountain National Battlefield Park
Chattahoochee River National Recreation Area	Martin Luther King, Jr. National Historic Site
Chickamauga and Chattanooga National Military Park	Ocmulgee National Monument
Cumberland Island National Seashore	Trail of Tears National Historic Trail
Fort Frederica National Monument	

Source: (NPS, 2015e)



Source: (NPS, 2015k)

**Figure 6.1.8-4: Cumberland Island National Seashore**

<sup>121</sup> This count is based on the NPS website “by the numbers” current as of 9/30/2014 (NPS, 2015e). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

## **National Forests**

The USFS manages one National Forest in Georgia, the Chattahoochee-Oconee National Forest (Figure 6.1.8-2). This forest is 867,000 acres, with streams, rivers, 850 miles of recreation trails, and lands rich in natural scenery, history, and culture (USFS, 2015b).

## **U.S. Army Corps of Engineers Recreation Areas**

There are ten USACE managed recreation areas within Georgia, Allatoona Lake, Carters Lake, George W. Andrews Lake, Hartwell Lake, J. Strom Thurmond Lake, Lake Seminole, Lake Sidney Lanier, Richard B. Russell Lake, Walter F. George Lake, and West Point Lake (see Figure 6.1.8-2) (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, 2017).

## **Tennessee Valley Authority Recreation Areas**

The Tennessee Valley Authority “manages public lands for multiple benefits” and “protects natural resources while providing recreational opportunities across the Valley” (TVA, 2015). TVA is the land and water steward for three reservoirs in Georgia, including Blue Ridge, Nottely, and a portion of Chatuge Reservoirs, and considers the impacts of activities on the environment “to ensure the unique and beautiful Valley resources [are] preserved” (see Figure 6.1.8-2) (TVA, 2015). TVA manages recreational, natural, and cultural resources in these areas to improve water quality, shoreline conditions, recreation, and biodiversity (TVA, 2015).

## **Federal Trails**

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails (NST) are defined as extended trails that “provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass” (NPS, 2012a). There is one National Scenic Trail in Georgia, the Appalachian National Scenic Trail (see Figure 6.1.8-2), which consists of 2,185 miles stretching from Maine to Georgia (NPS, 2015e).

The National Trails System Act defines National Historic Trails (NHTs) as “extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance” (NPS, 2012b). There is one National Historic Trail in Georgia, the Trail of Tears (see Figure 6.1.8-2), which commemorates the forceful removal of the Cherokee people from their homelands in Georgia, Alabama, and Tennessee to live in Indian Territory, now Oklahoma (NPS, 2015e).

In addition to National Scenic and 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. In Georgia there are 23 National Recreation Trails administered by the USFS, USACE, USFWS, local and state governments and non-profit organizations. (American Trails, 2015)

**6.1.8.6. Natural Areas**

**National Wilderness Areas**

In 1964 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” (Wilderness.net, 2015a). This Act defined wilderness as land untouched by man and primarily affected only by the “forces of nature” and as that which “may also contain ecological, geological, or other features of scientific, education, scenic, or historical value” (Wilderness.net, 2015b). 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 USFS, BLM, and USFWS (NPS, 2015l). Georgia is home to 14 federally managed Wilderness Areas as shown in Table 6.1.8-6 and Figure 6.1.8-2 (Wilderness.net, 2015c).

**Table 6.1.8-6: Georgia National Wilderness Areas**

NWA Name	
Big Frog Wilderness	Mark Trail Wilderness
Blackbeard Island Wilderness	Okefenokee Wilderness
Blood Mountain Wilderness	Raven Cliffs Wilderness
Brasstown Wilderness	Rich Mountain Wilderness
Cohutta Wilderness	Southern Nantahala Wilderness
Cumberland Island Wilderness	Tray Mountain Wilderness
Ellicott Rock Wilderness	Wolf Island Wilderness

Source: (Wilderness.net, 2015c)

**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. A portion of only one river, the Chattooga River (49.2 miles), has been designated as wild and scenic (see Figure 6.1.8-2).

Georgia has four state scenic rivers: Jacks River (16 miles), Conasauga River (17 miles), Chattooga River (34 miles), and Ebenezer Creek (7 miles). This designation protects the river from dams or other structures that may be built that would impede the natural flow (Georgia River Network Water Trails Website, 2015).

**National Wildlife Refuges (NWR) and State Wildlife Management Areas (WMA)**

NWRs are a network of lands and waters managed by the 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, 2015ck). There are nine NWRs in Georgia as shown in Figure 6.1.8-2 and Table 6.1.8-7 (USFWS, 2015cl).

The Savannah Coastal Refuges Complex is comprised of seven national wildlife refuges, totaling 56,949 acres, including the Savannah NWR (Figure 6.1.8-5). The Savannah NWR is 29,175 acres of freshwater marshes, tidal rivers and creeks, and bottomland hardwoods (USFWS, 2015cm).

**Table 6.1.8-7: Georgia National Wildlife Refuges**

NWR Name	
Banks Lake NWR	Piedmont NWR
Blackbeard Island NWR	Savannah NWR
Bond Swamp NWR	Wassaw NWR
Harris Neck NWR	Wolf Island NWR
Okefenokee NWR	

Source: (USFWS, 2015cl)



Source: (USFWS, 2015cm)

**Figure 6.1.8-5: Savannah NWR**

**State Wildlife Management Areas**

The GADNR’s Wildlife Resources Division manages over 100 State Wildlife Management Areas, Natural Areas, and Heritage Preserves for the benefit of wildlife (GADNR, 2015z).

**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, 2012c). These landmarks may be considered visual resources or visually sensitive. In Georgia, there are 11 NNLs as shown in Table 6.1.8-8 and Figure 6.1.8-2. Wassaw Island (Figure 6.1.8-6) is located primarily within the Wassaw National Wildlife Refuge, and “is one of the few remaining sea island ecosystems where natural processes of succession, erosion, and deposition, relatively unaffected by human activities, are demonstrated” (NPS, 2012d) (NPS, 2017).

**Table 6.1.8-8: Georgia National Natural Landmarks**

NNL Name	
Big Hammock Natural Area	Marshall Forest
Camp E.F. Boyd Natural Area	Okefenokee Swamp
Cason J. Calloway Memorial Forest	Panola Mountain
Ebenezer Creek Swamp	Wade Tract Preserve
Heggie’s Rock	Wassaw Island
Lewis Island Tract	

Source: (NPS, 2012c)



Source: (NPS, 2012d)

**Figure 6.1.8-6: Wassaw Island**

**6.1.8.7. 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. Georgia has one designated National Scenic Byway, the Russell-Brasstown National Scenic Byway (Figure 6.1.8-2). The 40.6-mile byway traverses the Chattahoochee National Forest and southern Appalachians (FHWA, 2015d) (See Figure 6.1.1-1 in Section 6.1.1, Infrastructure).

Similar to National Scenic Byways, the Georgia Department of Transportation administers Georgia’s Scenic Highways and Byways program. There are 14 State Byways as listed in Table 6.1.8-9) (Georgia.gov, 2015).

**Table 6.1.8-9: Georgia Scenic Highways and Byways**

State Highway or Byway Name	
Altamaha	Meriwether-Pike
Cohutta-Chattahoochee	Millen-Jenkins County
Enduring Farmlands	Monticello Crossroads
Historic Effingham-Ebenezer	Ocmulgee-Piedmont
Historic Dixie	Ridge and Valley
Historic Piedmont	South Fulton
I-185	Warren County-Piedmont

Source: (Georgia.gov, 2015)

## 6.1.9. Socioeconomics

### 6.1.9.1. Definition of the Resource

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

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet’s mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be *less than significant* at the programmatic level given the short-term nature of the deployment activities.

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 (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders). This PEIS addresses environmental justice in a separate section (Section 6.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and

recreation (Section 6.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 6.1.1, Infrastructure), and aesthetic considerations (Section 6.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau<sup>122</sup> (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016).

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.

### **6.1.9.2. 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.

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<sup>122</sup> 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. Additionally, the data contained in the FirstNet tables may incorporate data from multiple sources and may not be readily available in one table on the Census site.

### 6.1.9.3. *Communities and Populations*

This section discusses the population and major communities of Georgia (GA) and includes the following topics:

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

#### **Statewide Population and Population Growth**

Table 6.1.9-1 presents the 2014 population and population density of Georgia in comparison to the south region<sup>123</sup> and the nation. The estimated population of Georgia in 2014 was 10,097,343. The population density was 176 persons per square mile (sq. mi.), which was higher than the population density of both the region (114 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Georgia was the eighth largest state by population among the 50 states and the District of Columbia, 21<sup>st</sup> largest by land area, and had the 18<sup>th</sup> greatest population density (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015d).

**Table 6.1.9-1: Land Area, Population, and Population Density of Georgia**

<b>Geography</b>	<b>Land Area (sq. mi.)</b>	<b>Estimated Population 2014</b>	<b>Population Density 2014 (persons/sq. mi.)</b>
Georgia	57,513	10,097,343	176
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

Source: (U.S. Census Bureau, 2015f; U.S. Census Bureau, 2015d)

Population growth is an important subject for this PEIS, given FirstNet’s mission. Table 6.1.9-2 presents the population growth trends of Georgia from 2000 to 2014 in comparison to the south region and the nation. The state’s annual growth rate decreased in the 2010 to 2014 period compared to 2000 to 2010, from 1.70 percent to 1.04 percent. Georgia had higher growth rates in both periods compared to the nation.

<sup>123</sup> The south region includes the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas. Throughout the socioeconomics section, figures for the south region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the south region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

**Table 6.1.9-2: Recent Population Growth of Georgia**

Geography	Population			Numerical Population Change		Rate of Population Change (AARC) <sup>a</sup>	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Georgia	8,186,453	9,687,653	10,097,343	1,501,200	409,690	1.70%	1.04%
South Region	86,516,862	99,487,696	104,109,977	12,970,834	4,622,281	1.41%	1.14%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

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

<sup>a</sup> AARC = Average Annual Rate of Change (compound growth rate)

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use population projections that apply the same methodology across the nation. It is also useful to consider projections that use different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 6.1.9-3 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 Weldon Cooper Center, 2015a). 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 Georgia’s population will increase by approximately 2.1 million people, or 20.5 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 1.17 percent, which is slightly higher than the historical growth rate from 2010 to 2014 of 1.04 percent. The projected growth rate of the state is higher than that of the region (0.97 percent) and that of the nation (0.80 percent).

**Table 6.1.9-3: Projected Population Growth of Georgia**

Geography	Population 2014 (estimated)	Projected 2030 Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) <sup>a</sup> 2014 to 2030
Georgia	10,097,343	12,415,730	11,910,320	12,163,025	2,065,682	20.5%	1.17%
South Region	104,109,977	122,323,551	120,794,020	121,558,786	17,448,809	16.8%	0.97%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

Source: (U.S. Census Bureau, 2015f; ProximityOne, 2015; UVA Weldon Cooper Center, 2015b)

<sup>a</sup> AARC = Average Annual Rate of Change (compound growth rate)

## Population Distribution and Communities

Figure 6.1.9-1 presents the distribution and relative density of the population of Georgia. 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, 2015h).

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, 2015e) (U.S. Census Bureau, 2012). 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. Dispersed dots indicate dispersed population across the less densely settled areas of the state.

Table 6.1.9-4 provides the populations of the 10 largest population concentrations in Georgia, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.<sup>124</sup> In 2010, the largest population concentration by far was the Atlanta area, which had over 4.5 million people. The state had no other population concentrations over 1 million or between 500,000 and 1 million. It had seven population concentrations between 100,000 and 500,000. The smallest of these 10 population concentrations was the Albany area, with a 2010 population of 95,779. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Dalton area, with an annual growth rate of 3.99 percent. Six other areas (Athens-Clarke County, Atlanta, Georgia portion of Augusta-Richmond County, Gainesville, Savannah, and Warner Robins) also had growth rates over 1.00 percent. The Georgia portion of Columbus area experienced a population decline during this period.

Table 6.1.9-4 also shows that the top 10 population concentrations in Georgia accounted for 61.6 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 82.4 percent of the entire state's growth.

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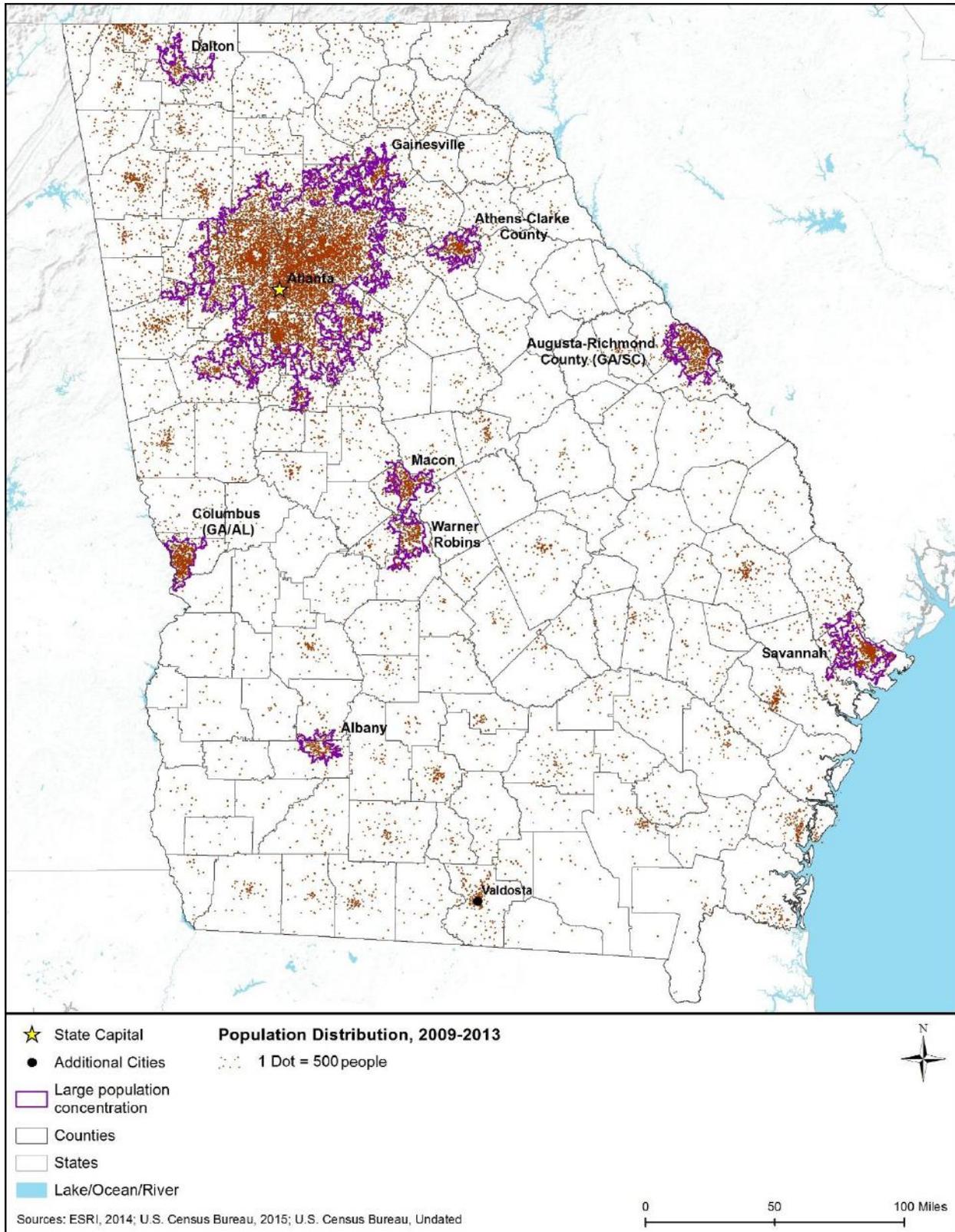
<sup>124</sup> Census Bureau boundaries for these areas are not fixed. Area changes from 2000 to 2010 may include accretion of newly developed areas into the population concentration, Census Bureau classification of a subarea as no longer qualifying as a concentrated population due to population losses, and reclassification by the Census Bureau of a subarea into a different population concentration. Thus, population change from 2000 to 2010 reflects change within the constant area and change as the overall area boundary changes. Differences in boundaries in some cases introduce anomalies in comparing the 2000 and 2010 populations and in calculation of the growth rate presented in the table.

**Table 6.1.9-4: Population of the 10 Largest Population Concentrations in Georgia**

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC) <sup>a</sup>
Albany	95,450	95,779	95,789	9	329	0.03%
Athens-Clarke County	106,482	128,754	129,313	8	22,272	1.92%
Atlanta	3,499,840	4,515,419	4,601,359	1	1,015,579	2.58%
Augusta-Richmond County (GA/SC) (GA Portion)	250,049	283,283	287,503	2	33,234	1.26%
Columbus (GA/AL) (GA Portion)	193,369	192,338	195,456	4	(1,031)	-0.05%
Dalton	57,666	85,239	84,912	10	27,573	3.99%
Gainesville	88,680	130,846	133,741	7	42,166	3.97%
Macon	135,170	137,570	137,651	5	2,400	0.18%
Savannah	208,886	260,677	266,853	3	51,791	2.24%
Warner Robins	90,838	133,109	134,534	6	42,271	3.89%
<b>Total for Top 10 Population Concentrations</b>	<b>4,726,430</b>	<b>5,963,014</b>	<b>6,067,111</b>	<b>NA</b>	<b>1,236,584</b>	<b>2.35%</b>
<b>Georgia (statewide)</b>	<b>8,186,453</b>	<b>9,687,653</b>	<b>9,810,417</b>	<b>NA</b>	<b>1,501,200</b>	<b>1.70%</b>
<b>Top 10 Total as Percentage of State</b>	<b>57.7%</b>	<b>61.6%</b>	<b>61.8%</b>	<b>NA</b>	<b>82.4%</b>	<b>NA</b>

Source: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j)

<sup>a</sup> AARC = Average Annual Rate of Change (compound growth rate)



**Figure 6.1.9-1: Population Distribution in Georgia, 2009–2013**

#### **6.1.9.4. Economic Activity, Housing, Property Values, and Government Revenues**

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 6.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

#### **Economic Activity**

Table 6.1.9-5 compares several economic indicators for Georgia to the south region and the nation. The table presents two indicators of income<sup>125</sup> – 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 6.1.9-5, the per capita income in Georgia in 2013 (\$24,923) was \$88 lower than that of the region (\$25,011), and \$3,261 lower than that of the nation (\$28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 6.1.9-5 shows that in 2013, the MHI in Georgia (\$47,765) was \$1,203 higher than that of the region (\$46,562), and \$4,485 lower than that of the nation (\$52,250).

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<sup>125</sup> The Census Bureau defines income as follows: “‘Total income’ is the sum of the amounts reported separately for wage or salary income; net self-employment income; interest, dividends, or net rental or royalty income or income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income. Receipts from the following sources are not included as income: capital gains, money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income “in kind” from food stamps, public housing subsidies, medical care, employer contributions for individuals, etc.; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump-sum receipts.” (U.S. Census Bureau, 2015k)

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 6.1.9-5 compares the unemployment rate in Georgia to the south region and the nation. In 2014, Georgia’s statewide unemployment rate of 7.2 percent was higher than the rate for the region (6.1 percent) and nation (6.2 percent).<sup>126</sup>

**Table 6.1.9-5: Selected Economic Indicators for Georgia**

<b>Geography</b>	<b>Per Capita Income 2013</b>	<b>Median Household Income 2013</b>	<b>Average Annual Unemployment Rate 2014</b>
Georgia	\$24,923	\$47,765	7.2%
South Region	\$25,011	\$46,562	6.1%
United States	\$28,184	\$52,250	6.2%

Source: (BLS, 2015b; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015m; U.S. Census Bureau, 2015n)

Figure 6.1.9-2 and Figure 6.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015l) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 6.1.9-1 (U.S. Census Bureau, 2012) (U.S. Census Bureau, 2015e). Following these two maps, Table 6.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Georgia.

Figure 6.1.9-2 shows that, in general, counties with a MHI above the national median were located in the central part of the northern part of the state around the Atlanta area, with a few such counties located sporadically throughout the state, typically just outside of other population concentrations. Most of the remainder of the state had MHI levels below the national average. The lowest MHI levels were generally located in the eastern and southern parts of the state. Table 6.1.9-6 is consistent with those observations. It shows that the Atlanta area had the highest MHI among the 10 largest population concentrations. With the exception of Warner-Robins, the area with the second highest MHI, the MHI in all other population concentrations was below the state average. MHI was lowest in Albany, Macon, Athens-Clarke County, and Dalton areas. Albany, Athens-Clarke, and Dalton areas were also among the four smallest areas shown in the table.

Figure 6.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It roughly matches the pattern in Figure 6.1.9-2. Counties with unemployment rates below the national average (that is, better employment performance) were located in the central part of the northern portion of the state, with some counties dispersed around the state. All other counties

<sup>126</sup> The timeframe for unemployment rates can change quarterly.

had unemployment rates above the national average. High unemployment rates were particularly prevalent in the southern half of the state. When comparing unemployment in the population concentrations to the state average (Table 6.1.9-6), half of the areas had unemployment rates above the state average and half were below the state average.

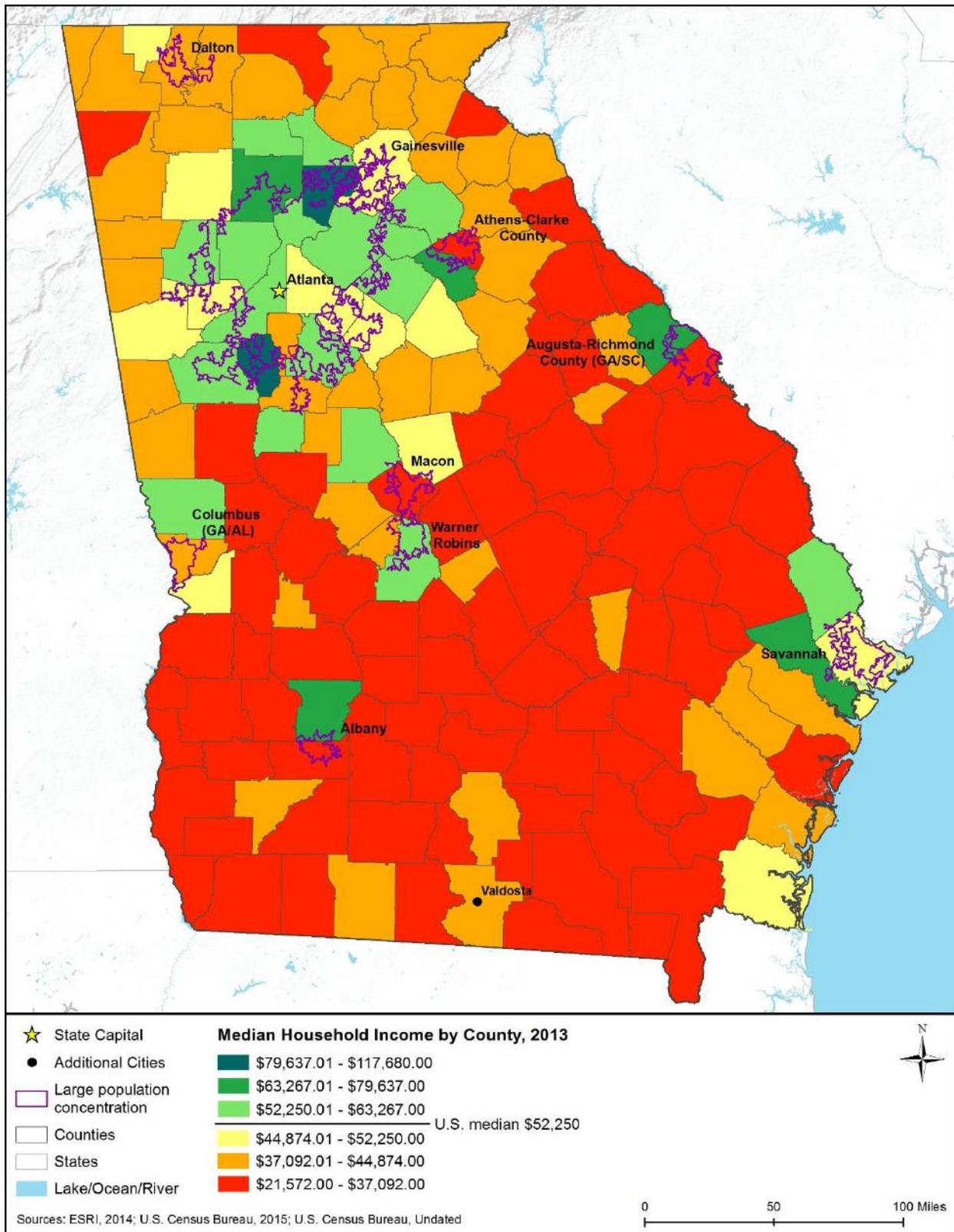
Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 6.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers was nearly identical in Georgia compared to the south region and the nation. The percentage of government workers was slightly higher in the state than in the region and nation. The percentage of self-employed workers was slightly lower in the state compared to the region and nation.

By industry, Georgia has a mixed economic base. Its distribution of employment by industry is very similar to that of the region and nations. Some minor differences shown in the table are as follows. Georgia in 2013 had a lower percentage of persons working in “agriculture, forestry, fishing and hunting, and mining” than did the region or the nation. It had a slightly higher percentage of workers in the “information” industry than the region. It had a lower percentage of workers in “educational services, and health care and social assistance” than the region or nation. No other industry had a considerably higher or lower percentage compared to the region or nation.

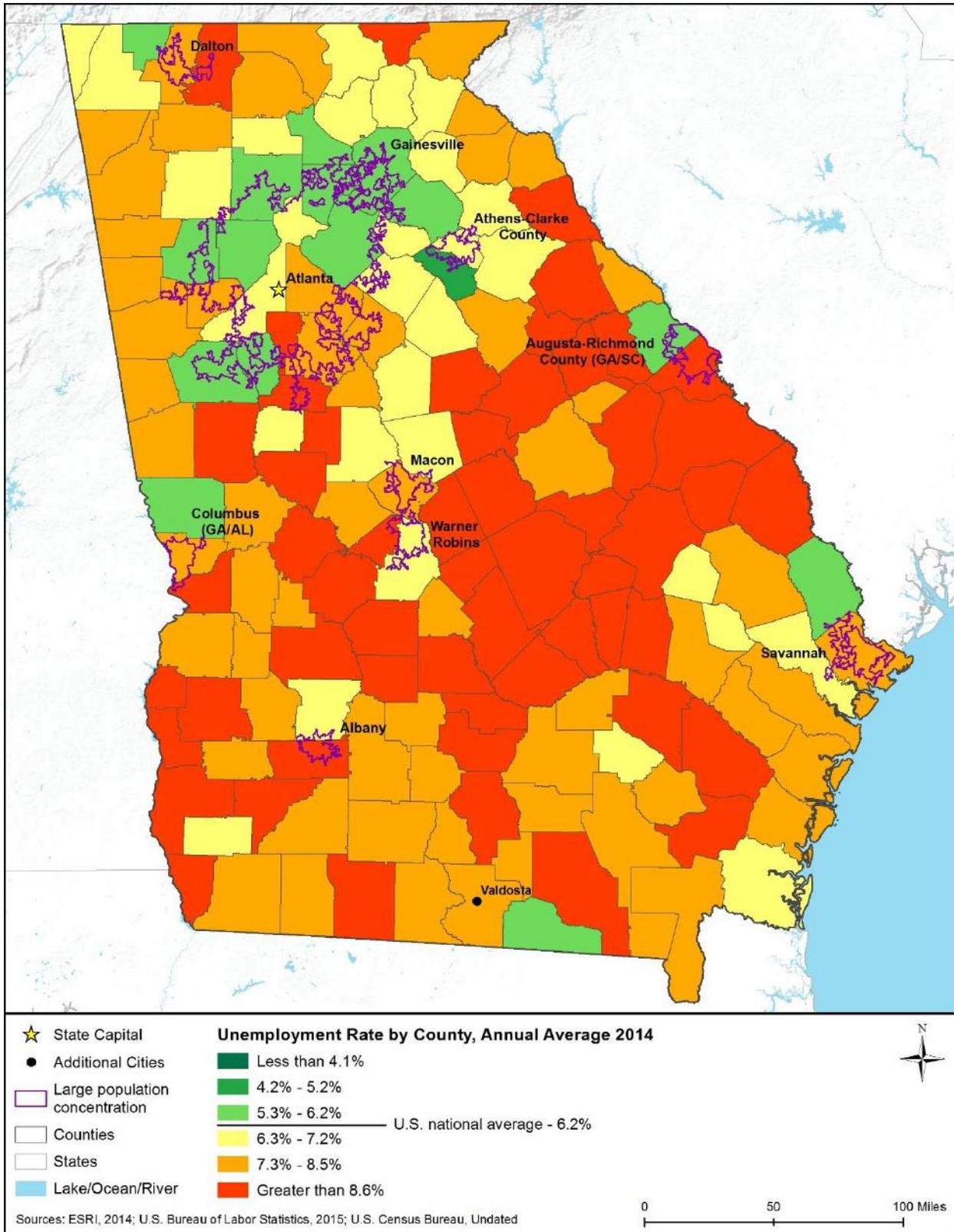
**Table 6.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Georgia, 2009–2013**

Area	Median Household Income	Average Annual Unemployment Rate
Albany	\$33,353	15.9%
Athens-Clarke County	\$36,076	9.0%
Atlanta	\$57,333	11.5%
Augusta-Richmond County (GA/SC) (GA Portion)	\$47,871	11.3%
Columbus (GA/AL) (GA Portion)	\$40,661	12.2%
Dalton	\$38,259	12.9%
Gainesville	\$47,782	9.3%
Macon	\$34,184	12.9%
Savannah	\$45,565	10.1%
Warner Robins	\$52,896	10.6%
Georgia (statewide)	\$49,179	11.4%

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



**Figure 6.1.9-2: Median Household Income in Georgia, by County, 2013**



**Figure 6.1.9-3: Unemployment Rates in Georgia, by County, 2014**

**Table 6.1.9-7: Employment by Class of Worker and by Industry, 2013**

<b>Class of Worker and Industry</b>	<b>Georgia</b>	<b>South Region</b>	<b>United States</b>
Civilian Employed Population 16 Years and Over	4,347,839	45,145,155	145,128,676
<b>Percentage by Class of Worker</b>			
Private wage and salary workers	79.2%	79.4%	79.7%
Government workers	15.1%	14.5%	14.1%
Self-employed in own not incorporated business workers	5.5%	5.9%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
<b>Percentage by Industry</b>			
Agriculture, forestry, fishing and hunting, and mining	1.3%	2.4%	2.0%
Construction	6.3%	6.9%	6.2%
Manufacturing	10.6%	9.9%	10.5%
Wholesale trade	3.0%	2.8%	2.7%
Retail trade	11.8%	12.1%	11.6%
Transportation and warehousing, and utilities	5.9%	5.2%	4.9%
Information	2.6%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	6.5%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	11.2%	10.5%	11.1%
Educational services, and health care and social assistance	20.9%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.5%	9.9%	9.7%
Other services, except public administration	5.0%	5.2%	5.0%
Public administration	5.4%	4.8%	4.7%

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

Table 6.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 6.1.9-7 for 2013.

**Table 6.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Georgia, 2009–2013**

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Albany	3.2%	4.1%	2.0%	9.4%
Athens-Clarke County	3.2%	2.5%	1.2%	9.0%
Atlanta	6.1%	6.3%	3.5%	14.7%
Augusta-Richmond County (GA/SC) (GA Portion)	5.0%	4.5%	2.3%	10.7%
Columbus (GA/AL) (GA Portion)	4.9%	4.2%	1.7%	7.9%
Dalton	4.9%	3.8%	1.0%	7.1%
Gainesville	9.2%	3.8%	1.7%	8.9%
Macon	5.2%	4.6%	1.2%	9.5%
Savannah	5.5%	6.5%	1.6%	9.3%
Warner Robins	5.7%	4.4%	1.0%	8.4%
Georgia (statewide)	6.5%	5.9%	2.5%	11.4%

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

## 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 6.1.9-9 compares Georgia to the south region and nation on several common housing indicators.

As shown in Table 6.1.9-9, in 2013, Georgia had a similar percentage of housing units that were occupied (86.3 percent) compared to the region (85.2 percent) and the nation (87.6 percent). Of the occupied units, Georgia had a similar percentage of owner-occupied units (62.7 percent) compared to the region (64.6 percent) and nation (63.5 percent). Georgia had a somewhat higher percentage of detached single-unit housing (also known as single-family homes) in 2013 (66.3 percent) compared to the region (63.8 percent) and nation (61.5 percent). The homeowner vacancy rate in Georgia (2.6 percent) was similar the rate for the region (2.2 percent) and was higher than the rate for the nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2013c). The vacancy rate among rental units was higher in Georgia (9.3 percent) than in the region (8.5 percent) or nation (6.5 percent).

**Table 6.1.9-9: Selected Housing Indicators for Georgia, 2013**

Geography	Total Housing Units	Housing Occupancy and Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Georgia	4,110,162	86.3%	62.7%	2.6%	9.3%	66.3%
South Region	44,126,724	85.2%	64.6%	2.2%	8.5%	63.8%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

Table 6.1.9-10 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 6.1.9-10 shows that during this period, the percentage of occupied housing units ranged from 80.4 percent to 89.4 percent across these population concentrations.

**Table 6.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Georgia, 2009–2013**

Area	Total Housing Units	Housing Occupancy and Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Albany	40,404	88.6%	46.4%	3.2%	8.3%	60.4%
Athens-Clarke County	54,901	82.2%	46.7%	4.5%	15.1%	50.1%
Atlanta	1,867,323	88.1%	63.7%	3.5%	11.3%	64.8%
Augusta-Richmond County (GA/SC) (GA Portion)	119,935	85.3%	61.5%	4.2%	10.0%	68.8%
Columbus (GA/AL) (GA Portion)	82,594	86.7%	50.5%	3.4%	9.7%	64.7%
Dalton	33,035	86.4%	60.3%	3.6%	17.9%	60.4%
Gainesville	48,917	89.4%	61.8%	2.7%	9.0%	69.1%
Macon	62,968	80.4%	51.1%	4.4%	14.1%	65.8%
Savannah	115,181	86.8%	56.0%	2.7%	8.9%	61.4%
Warner Robins	55,676	88.3%	64.7%	2.4%	12.2%	71.0%
Georgia	4,094,812	85.9%	65.1%	3.2%	10.5%	66.5%

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

## Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 6.1.9-11 provides indicators of residential property values for Georgia and compares these values to values for the south region and nation. The figures on median value of owner-occupied units are from the Census Bureau’s ACS, based on owner estimates of how much their property (housing unit and land) would sell for if it were for sale (U.S. Census Bureau, 2013c).

The table shows that the median value of owner-occupied units in Georgia in 2013 (\$141,600) was higher than the corresponding value for the south region (\$137,752) and lower than the value for the nation (\$173,900).

**Table 6.1.9-11: Residential Property Values in Georgia, 2013**

Geography	Median Value of Owner-Occupied Units
Georgia	\$141,600
South Region	\$137,752
United States	\$173,900

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

Table 6.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Four areas (Athens-Clarke County, Atlanta, Gainesville, and Savannah) had median values higher than the state median value (\$151,300). The lowest values were in the same two areas – Macon and Albany – that had the lowest median household incomes (Table 6.1.9-6).

**Table 6.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Georgia, 2009–2013**

Area	Median Value of Owner-Occupied Units
Albany	\$117,500
Athens-Clarke County	\$164,100
Atlanta	\$174,700
Augusta-Richmond County (GA/SC) (GA Portion)	\$133,300
Columbus (GA/AL) (GA Portion)	\$129,100
Dalton	\$120,300
Gainesville	\$156,500
Macon	\$114,200
Savannah	\$171,200
Warner Robins	\$129,800
Georgia (statewide)	\$151,300

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

## 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, 2006a). 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 6.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure. General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 6.1.9-13 shows that state and local governments in Georgia in 2012 received less total revenue and less intergovernmental revenue<sup>127</sup> from the federal government on a per capita basis than their counterpart governments in the region and nation. Georgia state and local governments obtained less revenue from property taxes per capita than for those governments in the region and nation. For general sales taxes and selective sales taxes, Georgia state governments received less revenue and Georgia local governments received more revenue per capita compared to their counterparts in the region and nation. The state government in Georgia obtained no revenue from public utility taxes and local governments received less revenue per capita from this source than local governments in the region and nation. Individual and corporate income tax revenues, on a per capita basis, were lower for the Georgia state government than for state governments in the region and nation. Local governments in Georgia received no individual and corporate income tax revenues.

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<sup>127</sup> 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, 2006b).

**Table 6.1.9-13: State and Local Government Revenues, Selected Sources, 2012**

Type of Revenue	Georgia		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue (\$M)	\$40,644	\$42,432	\$524,374	\$449,683	\$1,907,027	\$1,615,194
Per capita	\$4,097	\$4,277	\$5,148	\$4,414	\$6,075	\$5,145
Intergovernmental Federal (\$M)	\$13,795	\$1,568	\$160,706	\$18,171	\$514,139	\$70,360
Per capita	\$1,391	\$158	\$1,578	\$178	\$1,638	\$224
Intergovernmental State (\$M)	\$0	\$10,184	\$0	\$115,088	\$0	\$469,147
Per capita	\$0	\$1,027	\$0	\$1,130	\$0	\$1,495
Intergovernmental Local (\$M)	\$288	\$0	\$2,815	\$0	\$19,518	\$0
Per capita	\$29	\$0	\$28	\$0	\$62	\$0
Property Taxes (\$M)	\$69	\$10,291	\$2,073	\$109,687	\$13,111	\$432,989
Per capita	\$7	\$1,037	\$20	\$1,077	\$42	\$1,379
General Sales Taxes (\$M)	\$5,304	\$3,856	\$82,651	\$25,836	\$245,446	\$69,350
Per capita	\$535	\$389	\$811	\$254	\$782	\$221
Selective Sales Taxes (\$M)	\$2,088	\$1,070	\$41,447	\$9,394	\$133,098	\$28,553
Per capita	\$211	\$108	\$407	\$92	\$424	\$91
Public Utilities Taxes (\$M)	\$0	\$344	\$5,101	\$4,745	\$14,564	\$14,105
Per capita	\$0	\$35	\$50	\$47	\$46	\$45
Individual Income Taxes (\$M)	\$8,142	\$0	\$38,637	\$1,226	\$280,693	\$26,642
Per capita	\$821	\$0	\$379	\$12	\$894	\$85
Corporate Income Taxes (\$M)	\$591	\$0	\$8,099	\$114	\$41,821	\$7,210
Per capita	\$60	\$0	\$80	\$1	\$133	\$23

Source: (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.

## 6.1.10. Environmental Justice

### 6.1.10.1. 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*).<sup>128</sup> 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, 2016d). Under the EO, each federal

<sup>128</sup> See <https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice>.

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

In 1997, the Council on Environmental Quality (CEQ) issued Environmental Justice: Guidance under the NEPA to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA 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 (Census Bureau).
- Environmental effects include social and economic effects. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment.” (CEQ, 1997)

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

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

The policy includes accountability for the implementation of the policy, a definitions section, and an appendix that contains a list of implementation tools available. (USEPA, 2014a)

### **6.1.10.2. Specific Regulatory Considerations**

Georgia currently does not have an environmental justice law, policy, or designated agency for ensuring environmental equity for low income or racial minority areas (Deganian, 2012). Three environmental justice-related legislative initiatives proposed since 1995 did not become law (University of California Hastings, 2010) (Deganian, 2012). These were the “Environmental Justice Act of 1995” (Georgia House of Representatives, 1995), the “Environmental Justice Act of 1997” (Georgia House of Representatives, 1997), and the “Georgia Brownfields Rescue, Redevelopment, Community Revitalization and Environmental Justice Act of 2006” (Georgia General Assembly, 2006). However, some local governments have addressed environmental justice. For instance, in 2013 Fulton County established a county-level environmental justice policy and program called the Environmental Justice Initiative “to promote environmental justice and protect environmentally stressed communities in unincorporated Fulton County” (Fulton County Government, 2013). Federal laws relevant to environmental justice are summarized in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

### **6.1.10.3. Environmental Setting: Minority and Low-Income Populations**

Table 6.1.10-1 presents 2013 data on the composition of Georgia’s population by race and by Hispanic origin. The state’s population has a considerably higher percentage of individuals who identify as Black/African American (31.0 percent) than the populations of the south region (18.4 percent) and the nation (12.6 percent). The percentages for all other races are similar or differ by only a few percentage points across the state, region, and nation. The state’s population of persons identifying as White (60.4 percent) is smaller than that of the south region (72.3 percent) or the nation (73.7 percent).

The percentage of the population in Georgia that identifies as Hispanic (9.1 percent) is considerably smaller than in the south region (18.8 percent) and the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Georgia’s All Minorities population percentage (45.4 percent) is slightly higher than that of the south region (42.3 percent) and somewhat higher than the nation’s figure (37.6 percent).

**Table 6.1.10-1: Population by Race and Hispanic Status, 2013**

Geography	Total Population (estimate)	Race							Hispanic	All Minorities <sup>a</sup>
		White	Black/ African Am	Am. Indian/ Alaskan Native	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races		
Georgia	9,992,167	60.4%	31.0%	0.2%	3.6%	0.0%	2.7%	2.1%	9.1%	45.4%
South Region	102,853,019	72.3%	18.4%	0.9%	2.6%	0.1%	3.3%	2.4%	18.8%	42.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

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

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

Table 6.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Georgia (19.0 percent) is similar to that of the south region (18.2 percent) and somewhat higher than the figure for the nation (15.8 percent).

**Table 6.1.10-2: Percentage of Population (Individuals) in Poverty, 2013**

Geography	Percent Below Poverty Level
Georgia	19.0%
South Region	18.2%
United States	15.8%

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

#### **6.1.10.4. Environmental Justice Screening Results**

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, 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. (See footnote 122 in Socioeconomics for further information on how data was calculated.)

Figure 6.1.10-1 visually portrays the results of the environmental justice population screening analysis for Georgia. The analysis used block group data from the Census Bureau’s American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015h) (U.S. Census Bureau, 2015r; U.S. Census Bureau, 2015s; U.S. Census Bureau, 2015t) and Census Bureau urban classification data (U.S. Census Bureau, 2012) (U.S. Census Bureau, 2015e).

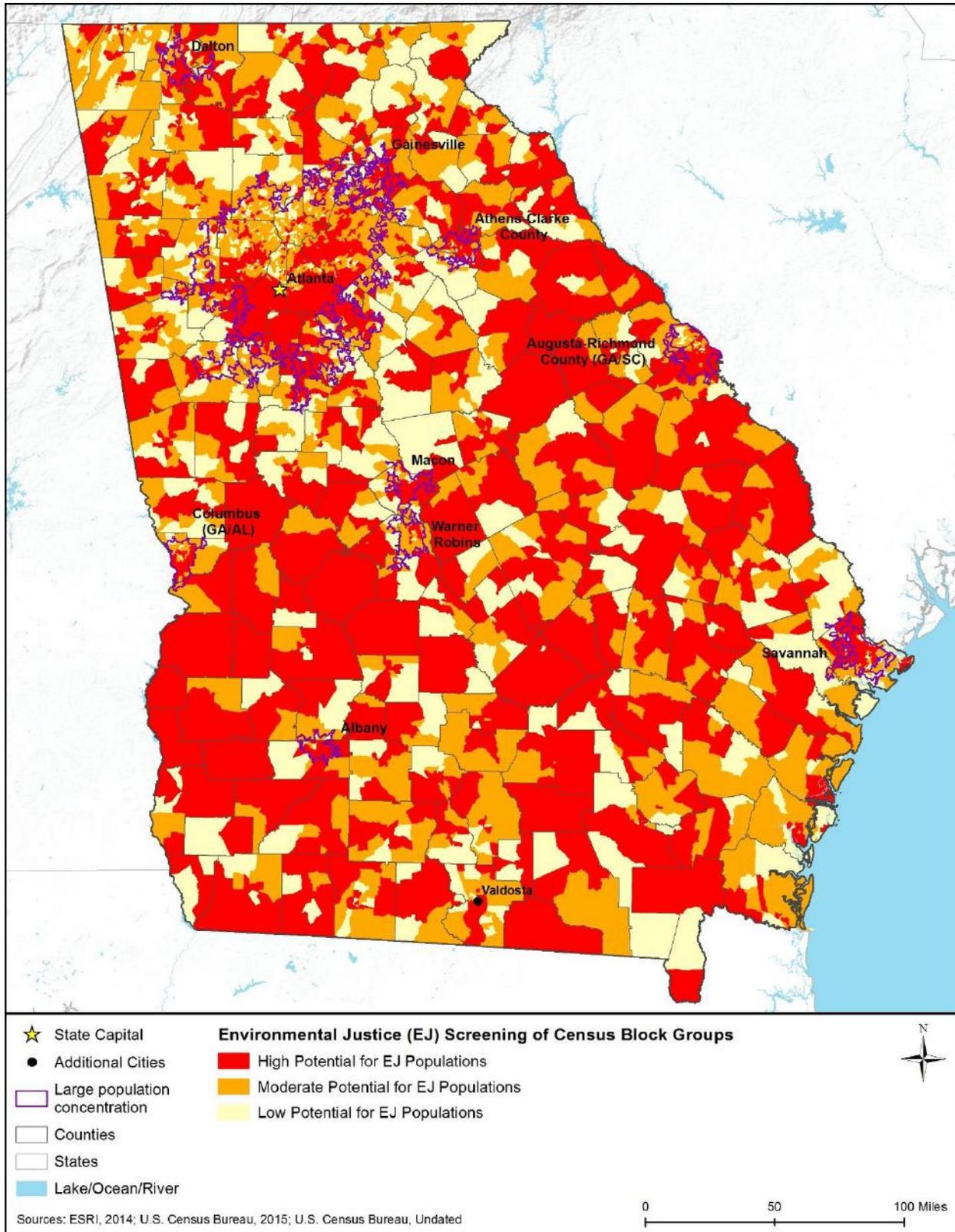
Figure 6.1.10-1 shows that Georgia has many areas with high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some

of the state's most sparsely populated areas, such as areas across the central part of the state. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state, with somewhat higher prevalence in the north.

It is important to understand how the data behind Figure 6.1.10-1 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 6.1.10-1 does not definitively identify environmental justice populations. It indicates degrees of likelihood of the presence of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to significance criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 6.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.



**Figure 6.1.10-1: Potential for Environmental Justice Populations in Georgia, 2009–2013**

## 6.1.11. Cultural Resources

### 6.1.11.1. Definition of the Resource

For the purposes of this PEIS, Cultural Resources are defined as:

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

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

- Statutory language and implementing regulations for Section 106 of the 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, 2016b); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

### 6.1.11.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of 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.

Georgia has state laws and regulations that are similar to NEPA (refer to Table 6.1.11-1). However, federal laws and regulations supersede state laws and regulations. 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 6.1.11-1: Relevant Georgia Cultural Resources Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Georgia Environmental Policy Act, Georgia Code Title 12, Chapter 16	Georgia State Historic Preservation Office (GASHPO)	This Regulation mirrors NEPA for actions on state actions, requiring agencies to consult with GASHPO regarding potential impacts to historic properties.
Georgia State Burial Site Statutes, Georgia Code Title 12-260, 12-3-53-82, 31-21-6, 31-21-5-6, 45, 36-72-16, and 12-3-52-54	GASHPO and local law enforcement	These laws prohibit the physical abuse or mistreatment of human remains, burials, grave markers, and associated objects. If a burial is uncovered during development or construction, work must stop immediately in the area and local law enforcement should be notified. Following determination that the site does not constitute a crime scene and the remains are a prehistoric or historic human burial, the GASHPO may assist the project proponent, developer, and/or landowner in contacting appropriate parties, considering options to avoid the burial(s), and advising on the legal process for potentially moving the remains.

Source: (GADNR, 2017c)

**6.1.11.3. Cultural Setting**

In Georgia, there is evidence of American Indian occupation dating back as early as 12000 BC. After the last ice-age the climate began to change, which created an environment that was conducive to human habitation throughout the Georgia (Sherwood, Driskel, Randall, & Meeks, 2004). The state is geographically associated with the southeastern United States lying between the Continental Margin and Coastal Plain physiographic provinces. There are many waterways and drainage areas throughout the state that provided the means for cultures to adapt and flourish. The rivers and streams that developed during and after the last ice age provided a means for transportation allowing for trade to develop. These waterbodies also provided a natural abundance of food sources that were exploited by early humans in the region. Eventually Georgia’s abundance of water, moderate climate and soils supported agricultural practices that are still prevalent to this day (NPS, 2015m).

The geology of the region provided an abundance of raw materials that American Indians used to make tools, which furthered their ability to flourish in the region. Since the beginning of human settlement in Georgia, the advancement of tool technology and the abundance of resources were crucial in the development of prehistoric societies (NPS, 2015m).

The climate in Georgia is humid and temperate like most of the southeast, which is conducive to a diverse array of biological species of plants and animals. Due to the abundance of natural food sources in the region, people were able to thrive and develop into complex social societies.

In addition to the hundreds of archaeological sites listed in the state’s inventory, there are twenty eight archaeological sites listed on the NRHP: thirteen are either historic, historic military, or later American Indian in origin; the other fifteen sites are prehistoric in origin (NPS, 2015e).

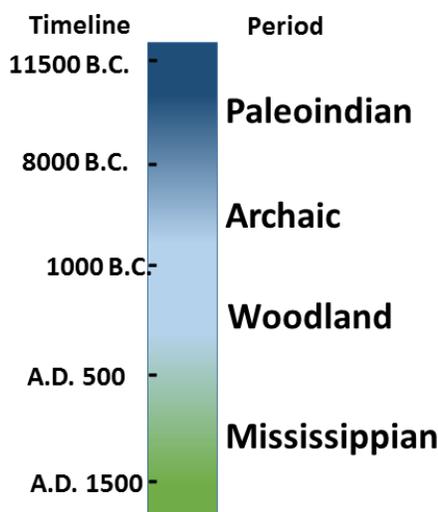
Archaeologists typically divide large areas into regions to concentrate their studies. As depicted in Figure 6.1.3-1, there are two physiographic region in Georgia: the Appalachian Highlands and Atlantic Plain. The Atlantic Plain encompasses the southern half of the state and is made up of the Coastal Plain province. The Appalachian Highlands spans the northern half of Georgia and

contains four provinces. The majority of the region is Piedmont except for along the northern state border, where there are parcels of the Appalachian Plateaus, Valley and Ridge, and Blue Ridge provinces (from east to west respectively).

The following sections provide additional detail about Georgia’s prehistoric periods (approximately 11500 BC to AD 1500) and the historic period since European exploration and colonization began in the 1500s. Section 6.1.11.4 presents an overview of the initial human habitation in Georgia and the cultural development that occurred before European contact. Section 6.1.11.5 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 6.1.11.6 provides a current list of significant archaeological sites in Georgia and tools that the state has developed to ensure their preservation. Section 6.1.11.7 document the historic context of the state since European contact, and Section 6.1.11.8 summarizes the architectural context of the state during the historic period.

**6.1.11.4. Prehistoric Setting**

There are four distinct periods associated with the prehistoric human populations that inhabited present day Georgia: The Paleoindian period (11500 to 8000 BC), Archaic (8000 to 1000 BC), Woodland (1000 B.C. to AD 500), and Mississippian (AD 500 to 1500). Figure 6.1.11-1 shows a timeline representing these periods of early human habitation in Georgia. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation has been discovered in every physiographic region of Georgia (Anderson, 1995).



Source: (Institute of Maritime History, 2015; Pauketat, 2012)

**Figure 6.1.11-1: Timeline of Prehistoric Human Occupation in Georgia**

**Paleoindian Period (11500 - 8000 B.C.)**

The Paleoindian Period represents the earliest human habitation of the southeast United States. During this period, the climate was cooler and wetter than in the Archaic Period that followed.

Evidence of early humans in Georgia is based on the discovery of fluted projectile points, commonly known as “arrowheads,” which are found in various conditions, including on the surface of the ground, in shallow soils, deep alluvial deposits, along the coast, and submerged under water. It is likely that the earliest people to occupy the state were small groups of nomadic hunters and gatherers that used a small inventory of chipped-stone tools known as “fluted javelin head” spear points or Clovis form spear point (fluted points). Archaeologists have concluded that humans of the Paleoindian Period formed small bands, which ranged across the state as they followed migratory game such, particularly large “megafauna” such as mammoths, mastodons, giant bison, and other large mammals before they became extinct. Paleoindians are believed to have lived in small family bands of around thirty to forty people, who followed large animal migrations and gathering wild plants. It is assumed that they were related to people who spread into North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Pichardo, 2005). Approximately 1,871 stone projectile points have been discovered in Georgia that are from the Paleoindian Period. Of these, 1,147 are fluted (of which 398 are from the Clovis culture), and 724 are other varieties. Towards the end of the Paleoindian Period, the climate began to warm and sea levels began to rise as glaciers melted and the last ice age ended (Anderson, et al., 2010; Walker, Detwiler, Meeks, & Driskell, 2001).

### **Archaic Period (8000 – 1000 BC)**

The temperatures became warmer and drier during the early Archaic Period and there was more seasonal variations in the climate. The various American Indian peoples were developing into cohesive family based units throughout the Archaic. By this time in North America the continent was experiencing the effects of the final glacial retreat from the last ice age. The climate would become much more like the present, and various flora and fauna now found in Georgia began to be established. The Archaic Period in Georgia is divided into the Early, Middle, and Late phases (Haag, 1961; Kelly & Hurst, 1956; Custer & Bachman, 1986).

Much like the Paleoindians that preceded them, early Archaic Period people were hunter-gathers whose diet consisted of wild plants and animals. Like the Paleoindians, their tool technology was based on chipped stone from which arrow points and other implements such as drills, choppers, flake knives, scrapers, gouges, and hammerstones, were manufactured. During the Archaic, people first began to develop permanent settlements around streams and rivers where potable water could be found. Archaeologists estimate that populations were beginning to grow, based on the number of archaeological sites from this period that have been found (Haag, 1961; NPS, 2015m).

By the Middle Archaic Period, populations steadily increased and societies became more regionalized. Tools became more sophisticated and the first sign of grinding implements that have been discovered date from this period; demonstrating that horticulture started to take hold (Alvey, 2005).

People continued to hunt and gather wild plants that were available for consumption. Shellfish collecting along river valleys and the seacoast continued to increase during this period. Archaeological sites discovered from the Middle Archaic including storage pits, remains of

house floors, and burials are all indications that more groups were beginning to be more sedentary, at least seasonally (NPS, 2015n; Alvey, 2005).

The Late Archaic Period of Georgia and much of the southeastern United States experienced an increasing trend towards regionalization and a continued increase in sedentary societies. The earliest evidence of fiber-tempered fired and decorated pottery in North America becomes evident in the archaeological record in the Savannah River Valley (Waggoner, 2009). “At present, there is no evidence of long-term habitation sites in Middle Archaic Georgia” (GADOT, 2009). There is evidence of houses being built during the late archaic period (Pluckhahn, 2010).

What is known as the Gulf Formational Period occurred during the Late Archaic Period around 4,500 to 3,200 years ago in Georgia, northern Florida, South Carolina, middle Tennessee, and eastern Mississippi. Fiber-tempered ceramic technology was invented as a result of “trade between the Stallings Island and Orange cultures of the south Atlantic coast and the Poverty Point culture of the lower Mississippi River Valley” (NPS, 2016c). At the end of the Archaic and throughout the Woodland Period, the development of pottery can be distinguished over time by an undecorated and untempered type, then to a fiber-tempered type, then lastly to decorated fabric impressed and cord-marked, sand-tempered types (NPS, 2015m; Waggoner, 2009).

Along the southeastern coast of Georgia, the exploitation of shellfish became well established. This is evident from the archaeological sites that were small, coastal fishing villages. Many of these sites are presently submerged (Thompson V. D., 2007). Shellfishing was also occurring along waterways within the interior of southeastern Georgia (Reitz, 1988). The Pile Dwelling culture developed a strategy for surviving within the harsh wetland environment along the coast and the interior of Georgia (Crook, 2007).

### **Woodland Period (1000 BC – AD 500)**

Similar to the Archaic Period, the Woodland Period is divided into three sequential Stages: Early, Middle, and Late. The three Stages are defined by phases of cultural development, based on archaeological evidence at temporal (place in time) locations. During the course of the Woodland Period, there is a continuing shift by area populations from semi-nomadic to more sedentary lifestyles and a continued expansion of horticulture and crop growing practices. (Reitz, 1988) (Pluckhahn, 2010)

Hunting and fishing was the predominant form of subsistence during the Early Woodland Stage. Although more deliberate attempts at farming began to be established, the collection of shellfish and other domesticated plants was also taking place. Identifying different types of pottery is typically how archaeologists differentiate between early, middle and late Woodland periods (NPS, 2015m).

During the Early Woodland and into the Middle Woodland Periods, there is evidence of sophisticated art being created. For example, a prehistoric mud glyph cave site in northern Georgia contains a wide variety of art forms, similar to cave art found in adjacent states. Archaeologists have attributed this work to the widespread prehistoric period art that was being created throughout the region. There continues to be an ever increasing discovery of this type of cave art throughout the southeastern United States (NPS, 2015m).

The practice of mound-building continued throughout the Middle Woodland period, and the mounds and required an extraordinary amount of coordinated labor. Towards the end of the Early Woodland and into the Middle Woodland there is evidence of long-distance trade networks. One example of this is meteoritic iron that was used for making various type of jewelry, beads, earspools, buttons, and headdresses which have been found in northern Florida; similar meteoritic iron artifacts have been found at the Tunacunnhee and Mandeville sites in Georgia (Carr & Sears, 1985). Ceremonial earthen mounds contained graves of elite individuals. Graves containing exotic gifts presumably provided with the intention of accompanying the dead into the afterlife are prevalent throughout the state (Reitz, 1988; Anderson & Schuldenrein, 1983).

Prehistoric art and architectural advancements are typically not attributed to the Late Woodland. The bow and arrow also replaced the atlatl, which allowed for greater efficiency in hunting (NPS, 2015m). Maize, beans, and squash cultivation increased along with more varieties of this important crop (NPS, 2015n).

### **Mississippian Period (AD 500 - 1500)**

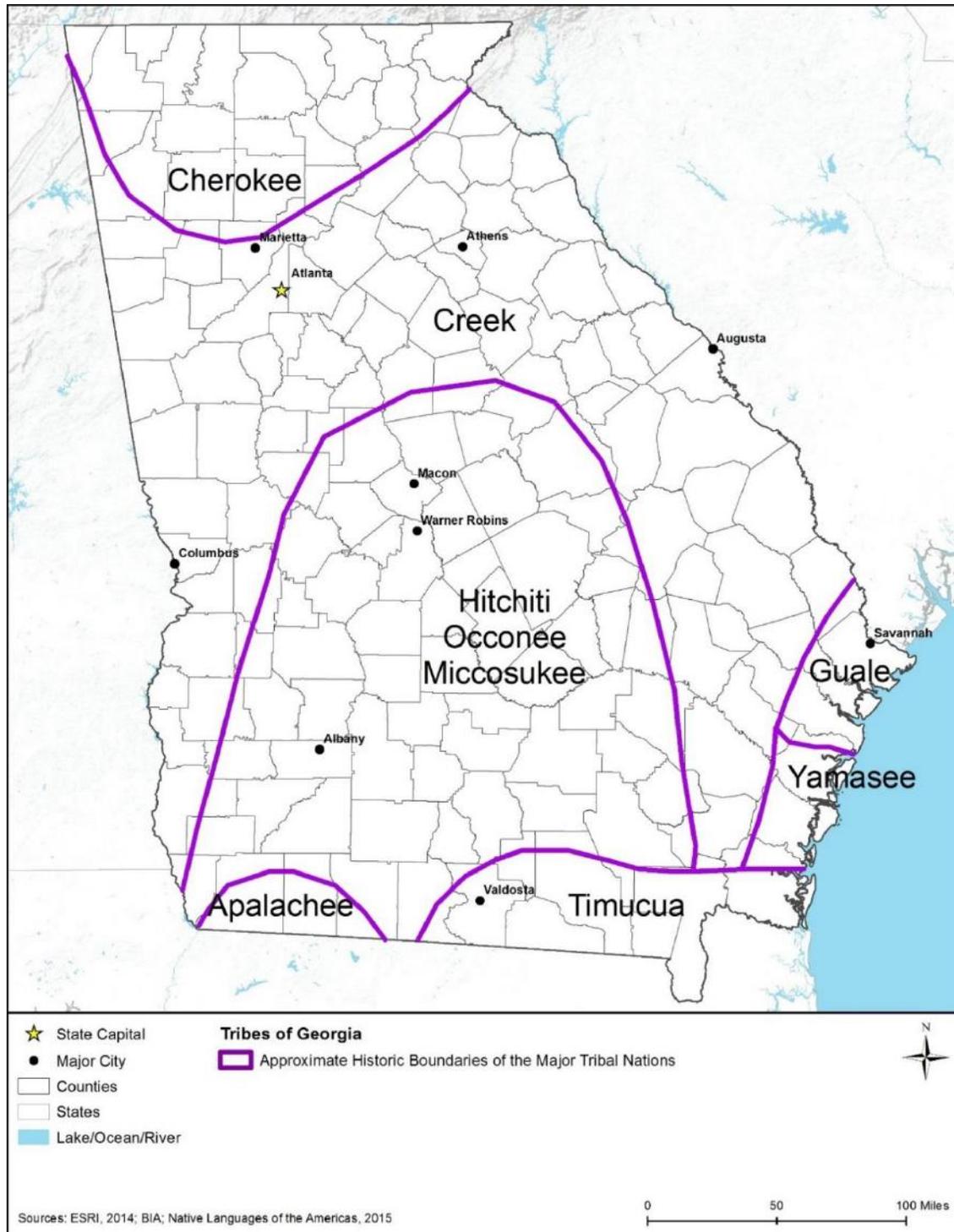
Since 2009, there has been increasing amount of research conducted on Mississippian Period archaeological sites aided by the use of new theories and methods of study. Most of the research conducted prior to 2009 was focused on the Chiefdom cultures that dominated most of the region. Recently, more focus has been placed on the research being conducted on the archaeological sites of cultures that existed outside of the major chiefdoms (Blitz, 2010; Jenkins & Krause, 2009).

However, the major chiefdoms of the Mississippian Period are considered to be among the most complex cultures ever to have existed in the prehistoric southeast, including Georgia. These chiefdoms developed elaborate social complexity and “an ideological belief system called the Southwestern Ceremonial Complex” involving complicated religious rites being practiced. They built “large platform mounds which were often concentrated in civic-ceremonial centers at the political capital of the chiefdoms (Bense, 1996).

Maize cultivation was generally important, but was not a central food crop in all of the Mississippian period societies. However, the long-term storage of food was becoming more commonplace and assisted in the development of social complexity by allowing people to focus their labor on work other than hunting and the harvesting of crops. Deer, fish, and different types of nuts were other important sources of food. In addition to maize agriculture, the exploitation of the coastal fish and shellfish remained important (Bense, 1996).

#### ***6.1.11.5. Federally Recognized American Indian Tribes of Georgia***

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are no federally recognized American Indian tribes in Georgia (NCSL, 2015; GPO, 2015b). Figure 6.1.11-2 shows the general historic location of officially federally recognized tribes that were known to exist in this region of the United States, but are no longer present in the state.



**Figure 6.1.11-2: Historic Boundaries of Major Tribal Nations in Georgia<sup>129</sup>**

<sup>129</sup> Figure 6.1.11-2 is provided for context and is not intended to be exact as the various sources that were consulted contain varying ancestral territory boundaries. Instead, this figure and corresponding ancestral territory boundaries are provided to show that the historic ancestral territories and the current ancestral interests of a given tribe within a given state are often times complex as ancestral territory boundaries shifted and overlapped over time.

**6.1.11.6. Significant Archaeological Sites of Georgia**

There are 46 archaeological sites in Georgia listed on the NRHP. Table 6.1.11-2 lists the names of the sites, the city they are closest to, and type of site. Both prehistoric and historic archaeological sites are listed. The number of archaeological sites increase as new sites are discovered. A current list of NRHP sites can be found on the NPS NRHP website at <http://www.nps.gov/nr/>. (NPS, 2015o)

**Table 6.1.11-2: Archaeological Sites on the National Register of Historic Places in Georgia**

Closest City	Site Name	Type of Site
Atlanta	DeKalb Avenue-Clifton Road Archeological Site	Historic
Atlanta	Soapstone Ridge	Prehistoric
Atlanta	Sweet Water Manufacturing Site	Historic, Prehistoric
Augusta	Stallings Island	Prehistoric
Blakely	Kolomoki Mounds	Prehistoric
Brunswick	Brunswick Old Town	Historic, Prehistoric
Buena Vista	Fort Perry	Historic, Military
Carrollton	Burns Quarry	Prehistoric
Cartersville	Etowah Mounds	Prehistoric
Cartersville	Etowah Valley District	Historic - Aboriginal, Military, Prehistoric
Cordele	Cannon Site	Prehistoric
Cox	Fort Barrington	Historic, Military
Dacula	Parks--Strickland Archeological Complex	Prehistoric
Dallas	Pickett's Mill Battlefield Site	Military
Dillard	Hoojah Branch Site (9RA34)	Prehistoric
Dublin	Fish Trap Cut	Prehistoric
Eatonton	Rock Eagle Site	Prehistoric
Fayetteville	Orkin Early Quartz Site	Prehistoric
Fort Gaines	Fort Gaines Cemetery Site	Historic, Prehistoric
Greensboro	Copeland Site (9GE18)	Prehistoric
Lumpkin	Singer-Moye Archeological Site	Prehistoric
Mableton	Johnston's Line	Military
Macon	Fort Hawkins Archeological Site	Historic
Marietta	Gilgal Church Battle Site	Military
Marietta	Kennesaw Mountain National Battlefield Park	Military
Marietta	Sope Creek Ruins	Historic - Aboriginal, Military
Midway	Fort Morris	Historic
Millen	Camp Lawton	Historic, Military
Omaha	Roods Landing Site	Prehistoric
Port Wentworth	Mulberry Grove Site	Historic, Prehistoric
Riceboro	Woodmanston Site	Historic
Richmond Hill	Seven Mile Bend	Historic, Prehistoric
Ringgold	Ringgold Gap Battlefield	Military
Savannah	Old Fort Argyle Site	Historic
Savannah	CSS GEORGIA (ironclad)	Shipwreck
Sparta	Hurt--Rives Plantation	Historic
St. Marys	Crooked River Site (9CAM118)	Prehistoric

Closest City	Site Name	Type of Site
St. Marys	Dungeness Historic District	Historic
St. Marys	Plum Orchard Historic District	Historic, Prehistoric
St. Marys	Rayfield Archeological District	Historic
St. Marys	Stafford Plantation Historic District	Historic
St. Marys	Table Point Archeological District	Prehistoric
St. Simons Island	Hamilton Plantation Slave Cabins	Historic,
Summerville	Georgia Site No. 9CG43	Prehistoric
Washington	Kettle Creek Battlefield	Military
Winfield	Woodville	Historic

Source: (NPS, 2015o)

### 6.1.11.7. *Historic Context*

The first Europeans to explore present-day Georgia were the Spanish, starting in 1526, when Lucas Vasquez de Ayllon attempted to establish a colony south of the eventual location of Savannah. The colony, known as San Miguel de Gualdape, was the first Spanish settlement in what would become the United States. It failed, however, after three months and the settlers left behind no lasting mark on the area. The exploring party Hernando de Soto came into present-day Georgia in 1540 and he was followed by other later Spanish explorers during the 16<sup>th</sup> and 17<sup>th</sup> centuries. Nearly 20 Spanish Catholic missions were established along Georgia’s barrier islands and interior rivers among local American Indian populations from the 1560s-1680s. Until the early 18<sup>th</sup> century, the land that is now Georgia remained a contested borderland between the Spanish colony of Florida and the English colony of South Carolina (Sullivan & Georgia Historical Society, 2003).

In early 1733, James Oglethorpe arrived as the head of an expedition to colonize Georgia on behalf of England, populating it with debtors from English prisons. Oglethorpe landed at the Yamacraw Bluff above the Savannah River and, after negotiating with the chief of the Yamacraw Indians, Tomochichi, he acquired the land needed to lay out the city of Savannah. Savannah’s town plan, which is largely intact, focuses on a series of public town squares, and is arguably one of the city’s most important cultural resources and has had tremendous influence on urban planning. Banned by Oglethorpe when the colony was created, slavery was introduced in the middle of the 18<sup>th</sup> century and was used in the colony to produce rice and indigo crops. During the American Revolution, Georgia was initially reluctant to support the cause, but soon joined the push for independence. Following an unsuccessful attempt to recapture the city in 1779 by French and American forces, British forces held Savannah and Augusta for much of the war, but withdrew in 1782 following the British defeat at Yorktown, Virginia. After the war, Georgia’s capital was moved to Augusta, which was more defensible due to being located further inland (Sullivan & Georgia Historical Society, 2003).

“The four decades following the end of the Revolution saw the expansion of Georgia into the interior until, by the early 1830s, the state had reached the limits of its present boundaries” (Sullivan & Georgia Historical Society, 2003). As settlers pushed deeper into the continent, land disputes with American Indians arose. In 1838, the remaining Creek and Cherokee people were forcibly removed, culminating in the “Trail of Tears” which resulted in the death of thousands.

Before the Civil War, Georgia was one of the nation's leading producers of cotton. Important trading towns arose at fall lines on major rivers, with Macon, situated on the Ocmulgee River, and Columbus, located on the Chattahoochee River, being examples. Atlanta, originally called Terminus, and then Marthasville, is not located on a navigable river, but was established in the late 1830s as the end of the Western and Atlanta Railroad (Sullivan & Georgia Historical Society, 2003).

During the Civil War, northern Georgia was the site of several significant battles and experienced considerable destruction. During Union General William Tecumseh Sherman's "March to the Sea" in 1864, the City of Atlanta was besieged and suffered considerable damage. Sherman's columns pilfered the countryside and destroyed railroads, telegraph lines, bridges, arsenals and other infrastructure to forcibly bring the Confederacy to surrender. Sherman spared Savannah after the city surrendered in late December 1864, saving the city's historic buildings." (CivilWar.org, 2003) After the war, during the Reconstruction Era, Georgia faced difficulties coping with the destruction of the war. Eventually, due to its economic and transportation importance, Atlanta arose as the state's center of commerce. In rural areas, former slaves often stayed as sharecroppers on former plantations. The lumber industry grew as well, particularly in the "pine lands" located along the coast (Sullivan & Georgia Historical Society, 2003).

In the early 20<sup>th</sup> century, racial problems stemming from Jim Crow laws, Ku Klux Klan activity, and slumping economic conditions continued to plague the state. During World War I (WWI), many African Americans moved to cities, or left the South altogether in favor of northern cities to secure factory jobs; this trend continued through the Great Depression. In the 1930s, farmers benefited from New Deal programs that provided economic relief, while others found work through New Deal programs such as the Civilian Conservation Corps (CCC) (Sullivan & Georgia Historical Society, 2003).

During World War II (WWII), Georgians volunteer to fight in large numbers. Domestically they contributed through shipbuilding activities in Savannah and Brunswick, and the aircraft construction in Marietta. In addition "the U.S. Army established some of the nation's largest training bases at Fort Gordon near Augusta, Fort Benning near Columbus, and Camp Stewart near Savannah" (Sullivan & Georgia Historical Society, 2003). In the post-WWII years, civil rights became a major issue, with Dr. Martin Luther King Jr., an Atlanta native, serving as one of the movement's leaders. Suburbanization occurred around Atlanta during the Midcentury Era, resulting in many residents leaving the city. Cities like Augusta and Macon have declined, while Savannah has transitioned into an economy based largely on heritage tourism.

Georgia has 2,105 NRHP listed sites, as well as 49 NHLs (NPS, 2015e). Georgia contains two NHAs, the Arabia Mountain National Heritage Area, and a large portion of the Gullah/Geechee Heritage Corridor (NPS, 2015f). Figure 6.1.11-3 shows the location of NHA and NRHP sites within the state of Georgia.<sup>130</sup>

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<sup>130</sup> See Section 6.1.8 for a more information on additional historic resources as they relate to recreational resources.

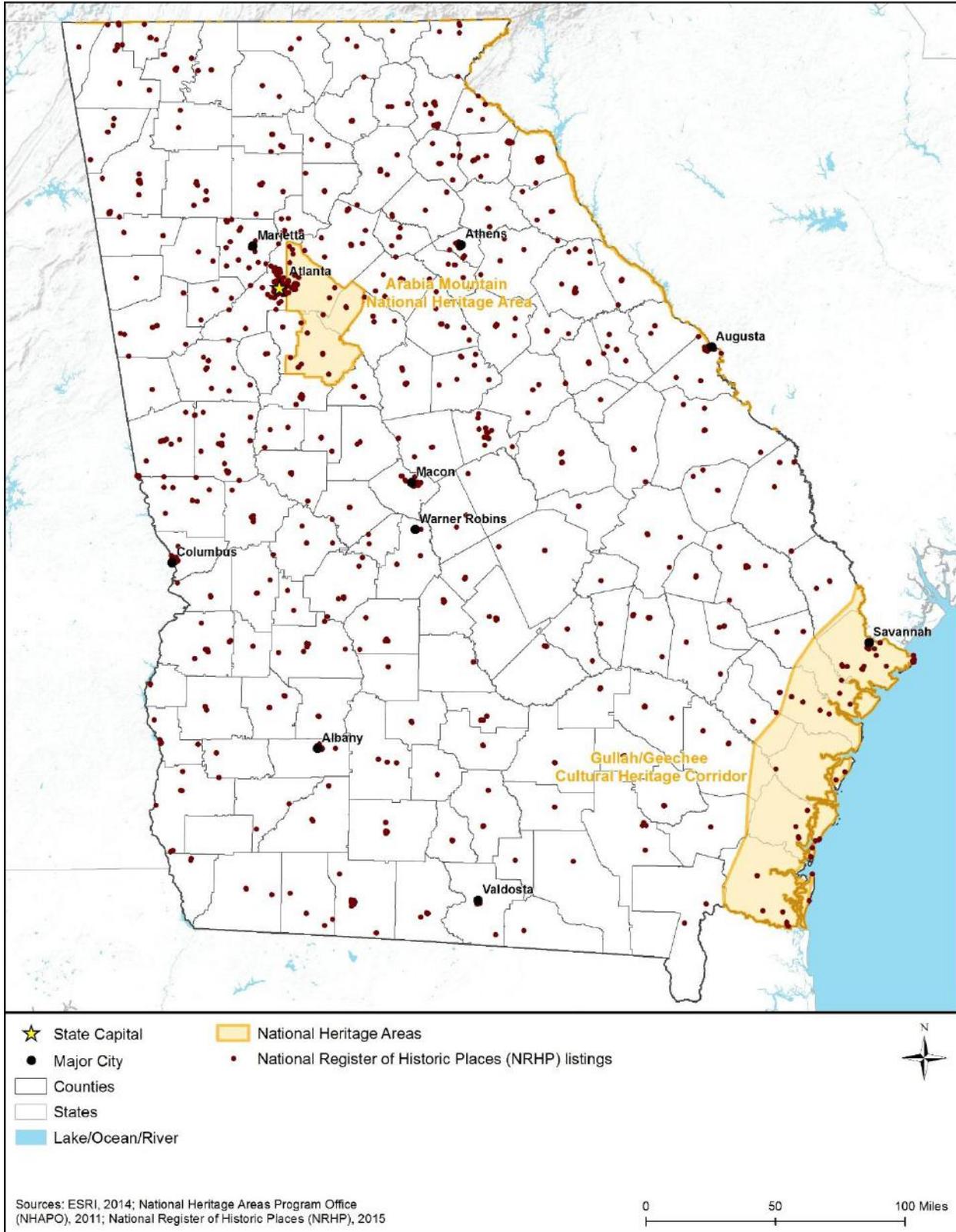


Figure 6.1.11-3: NHA and NRHP Sites in Georgia

### **6.1.11.8. Architectural Context**

Georgia has a wide variety of historic resources dating from the 18<sup>th</sup> century up through the middle of the 20<sup>th</sup> century. Historic houses compose approximately eighty percent of the buildings, varying from high-style to vernacular (GADNR, Historic Preservation Division, 2012). Early vernacular types include single pen (one room), hall and-parlor, dog-trot, log cabin, I-house, and others. Most structures were built of logs or wood framing, with more prominent examples being built of brick masonry, especially in areas like Savannah and Augusta. House types like the single pen and hall-parlor were built through the end of the 19<sup>th</sup> century, and bungalows were extremely popular in between WWI and WWII (GADNR, Historic Preservation Division, 2015a). Ranch houses dominated the Midcentury years, appearing both in suburban developments and rural communities (New South Associates, 2010). Many of the state's most impressive historic resources are in Savannah, with the Savannah Cottage Exchange (1886), Fort Pulaski (1847), and the Oglethorpe town plan being existing examples.

House styles in Georgia followed popular national trends. Georgian architecture was popular in Savannah prior to the American Revolution, and was replaced by the Federal style beginning around 1790, which lasted through the first quarter of the 19<sup>th</sup> century.<sup>131</sup> Classical Revival was popular beginning in the late 18<sup>th</sup> century and lasted into the early 19<sup>th</sup> century as well. Greek Revival was dominant from the second quarter of the 19<sup>th</sup> century through the onset of the Civil War. Gothic Revival and Italianate architecture failed to gain the popularity experienced elsewhere; however, both styles were built starting before the Civil War and continuing into the Reconstruction Era (GADNR, Historic Preservation Division, 1991).

Victorian Era styles were built during the latter part of the 19<sup>th</sup> century. Second Empire was more common in cities than in rural areas, while Queen Anne was popular broadly. During the early 20<sup>th</sup> century, a host of revival styles became popular, including Neoclassical, Colonial Revival, and English Vernacular Revival. Craftsman styles houses are common in Georgia's early suburbs (most of which have now become in-town neighborhoods), as well as in rural areas. The Craftsman and Prairie styles most often appear on bungalows (GADNR, Historic Preservation Division, 1991). The Inman Park neighborhood in Atlanta features many example of Queen Anne houses, while the Midtown and Virginian Highland neighborhoods features are predominantly populated with bungalows. During the Great Depression and following WWII, Art Moderne, Art Deco, International, and Midcentury Modern were common.

Historic commercial and institution architecture is common as well. Commercial buildings include community stores in rural areas, corner stores, retail and office, single retail, multiple retail, and office towers (GADNR, Historic Preservation Division, 2015b). Historic church types include front gable, central tower, corner tower, and double tower churches (GADNR, Historic Preservation Division, 2016a). Historic churches were decorated in the popular style of the time, with Gothic Revival serving becoming popular during the second half of the 19<sup>th</sup> century and lasting into the 20<sup>th</sup> century.

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<sup>131</sup> It is important to note that the "Georgian" style of architecture, as well as the aforementioned Georgian house, was not named after the state of Georgia, but rather after the succession of kings of England named George for much of the 18<sup>th</sup> century.

Georgia boasts a variety of historic educational facilities and building types including one and two room school buildings during the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, three-part and three-part with wings until the 1950s, and urban school forms in cities (GADNR, Historic Preservation Division, 2016b). During the Midcentury Era, schools features Midcentury Modern design principles, often with a variety of wings spreading out and containing classrooms (finger shaped design) (Ray & Associates, 2016). Georgia contains examples of historic Rosenwald Schools, funded by Sears Roebuck and Company’s president, Julius Rosenwald, for lower-income African Americans communities in rural areas (GASHPO, 2009).

Historic industrial facilities include mill buildings, warehouses, railroad depots, and many others. Many of these buildings have since been converted into residential lofts and other non-traditional uses. Agriculture has historically been of great importance to the state, and agricultural buildings are still found in great numbers. “They typically include farmhouses, tenant farmhouses, barns and sheds, storage and processing buildings, detached kitchens, smokehouses, blacksmith shops, and offices” (GADNR, Historic Preservation Division, 2012). Ponce City Market, formerly a retail and distribution center for Sears, Roebuck and Company in Atlanta, is an example of a building that was both industrial and commercial and has recently been adaptively reused. Georgia also contains a variety of historic military facilities, including training facilities, active basis, and facilities associated with the construction of military equipment during WWII. The Bell Plant in Marietta is an example of a factory that built B-29s during WWII.



Top Left – Georgia State Capitol (Atlanta, GA) – (Historic American Buildings Survey, 1980)

Top Middle – Savannah Cotton Exchange (Savannah, GA) – (Historic American Buildings Survey, 1933)

Top Right – Martin Luther King Jr. Birth Home (Atlanta, GA) – (Historic American Buildings Survey, 1979)

Bottom Left – Baldwin-Massey House (Madison, GA) – (Johnston, 1939)

Bottom Right – Bungalow (La Grange, GA) – (Historic American Engineering Record, 1968)

**Figure 6.1.11-4: Representative Architectural Styles of Georgia**

## 6.1.12. Air Quality

### 6.1.12.1. 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<sup>132</sup> 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)<sup>133</sup> or micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ) determined over various periods of time (averaging time).<sup>134</sup> This section discusses the existing air quality in Georgia. The USEPA designates areas within the United States as attainment,<sup>135</sup> nonattainment,<sup>136</sup> maintenance,<sup>137</sup> or unclassifiable<sup>138</sup> depending on the concentration of air pollution relative to ambient air quality standards. Information is presented regarding national and state ambient air quality standards and nonattainment areas that would be potentially more sensitive to impacts from implementation of the Proposed Action or alternatives.

### 6.1.12.2. Specific Regulatory Considerations

#### National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, nitrogen dioxide (NO<sub>2</sub>), particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), ozone (O<sub>3</sub>), and sulfur dioxide (SO<sub>2</sub>). The NAAQS establish various standards, either primary<sup>139</sup> or secondary,<sup>140</sup> for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure (USEPA, 2017b). A description of the NAAQS is presented in Appendix E, National Ambient Air Quality Standards.

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). HAPs can have severe adverse impacts on human health and the environment,

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<sup>132</sup> Topography: The unique features and shapes of the land (e.g., valleys and mountains).

<sup>133</sup> Equivalent to 1 milligram per liter (mg/L).

<sup>134</sup> 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, 2015g).

<sup>135</sup> Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2016h).

<sup>136</sup> 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, 2016h).

<sup>137</sup> 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, 2016h).

<sup>138</sup> 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, 2016h).

<sup>139</sup> 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, 2014b).

<sup>140</sup> 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, 2014b).

including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. Appendix E presents a list of federally regulated HAPs. (USEPA, 2016e)

In conjunction with the federal NAAQS, Georgia maintains its own air quality standards, the Georgia Ambient Air Quality Standards (GAAAQS). Table 6.1.12-1 presents an overview of the GAAAQS as defined by GADNR.

**Table 6.1.12-1: Georgia Ambient Air Quality Standards (GAAAQS)**

Pollutant	Averaging Time	Standard		Notes
		µg/m <sup>3</sup>	ppm	
CO	1-hour	40	-	Not to exceed.
	8-hour	10	-	
Lead	3-month	0.15	-	Arithmetic mean concentration over a 3-month period.
NO <sub>2</sub>	1-hour	-	0.1	1-hour average concentration.
	Annual	-	0.053	Annual arithmetic mean.
PM <sub>10</sub>	24-hour	150	-	Not to be exceeded for more than one such 24-hour period per year.
PM <sub>2.5</sub>	24-hour	35	-	The 98 <sup>th</sup> percentile 24-hour PM <sub>2.5</sub> concentration shall not exceed 35 µg/m <sup>3</sup> .
	Annual	12	-	Annual arithmetic mean concentration.
O <sub>3</sub>	8-hour	-	0.075	Daily maximum 8-hour average.
SO <sub>2</sub>	1-hour	-	0.075	
	3-hour	1,300	-	Ground level concentration not to be exceeded for more than one such three-hour period per year.
	24-hour	365	-	Ground level concentration not to be exceeded for more than one such twenty-four hour period per year.
	Annual	80	-	Annual arithmetic mean concentration.

Source: (GA R&R, 2015a)

### Title V Operating Permits/State Operating Permits

Georgia 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, 2015h). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015h). Georgia’s Rule 391-3-1-.03(10) [Title V Operating Permits] describes the applicability of Title V operating permits (GA R&R, 2015b). Georgia’s 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 6.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014c).

**Table 6.1.12-2: Major Air Pollutant Source Thresholds**

Pollutant	Tons per Year (TPY)
Any Pollutant	100
Single HAP	10
Total/Cumulative HAPs	25

Source: (USEPA, 2014d)

### Exempt Activities

Select activities, as defined by Rule 391-3-1-.03(6) [Exemptions], are exempt from the registration and permitting provisions of Rule 391-3-1-.03(2) [Operating State Implementation (SIP) Permit] for Georgia operating permits. The following activities are exempt from operating permitting requirements:

- “Mobile sources...;
- Fuel-burning equipment having a total heat input capacity of less than 10 million British thermal units<sup>141</sup> (BTU) per hour burning only natural gas, liquefied petroleum gas (LPG) and/or distillate fuel oil containing 0.50 percent sulfur by weight or less...;
- Any fuel-burning equipment with a rated input capacity of 2.5 million BTUs per hour or less...;
- Stationary engines:
  - Burning natural gas, LPG, gasoline, dual fuel, or diesel fuel which are used exclusively as emergency generators;
  - Burning natural gas, LPG, and/or diesel fuel and used for peaking power (including emergency generators used for peaking power) where the peaking power use does not exceed 200 hours-per-year except in the counties of Banks, Barrow, Bartow, Butts, Carroll, Chattooga, Cherokee, Clarke, Clayton, Cobb, Coweta, Dawson, DeKalb, Douglas, Fayette, Floyd, Forsyth, Fulton, Gordon, Gwinnett, Hall, Haralson, Heard, Henry, Jackson, Jasper, Jones, Lamar, Lumpkin, Madison, Meriwether, Monroe, Morgan, Newton, Oconee, Paulding, Pickens, Pike, Polk, Putnam, Rockdale, Spalding, Troup, Upson, and Walton where such engines with a rated capacity equal to or greater than 100 kilowatts are not exempt;
  - Used for other purposes provided that the total horsepower of all non-gasoline burning engines combined are less than 1500 engine horsepower and no individual engine operates for more than 1000 hours-per-year; and
  - Used for other purposes provided that the total horsepower of all gasoline burning engines combined are less than 225 horsepower and no individual engine operates for more than 1000 hours-per-year...
- Temporary stationary engines used to generate electricity that are used to replace main stationary engines during periods of maintenance or repair (provided the actual and potential emissions of the temporary sources do not exceed that of the main sources);

<sup>141</sup> One BTU is the amount of heat needed to raise the temperature of one pound of water by 1°F. (EIA, 2015b)

- Temporary fuel-burning equipment (i.e., boilers) that are used to replace main fuel-burning equipment during periods of maintenance or repair (provided the actual and potential emissions of the temporary sources do not exceed that of the main sources.) Temporary fuel-burning equipment that remains at a location for more than 180 consecutive days is no longer considered to be a temporary boiler. Temporary fuel-burning equipment that replaces temporary fuel-burning equipment at a location and is intended to perform the same or similar function will be included in calculating the consecutive time period;
- Stationary engines which are used exclusively as emergency generators<sup>142</sup> (by definition operating less than 500 hours-per-year, except in the counties of Banks, Barrow, Bartow, Butts, Carroll, Chattooga, Cherokee, Clarke, Clayton, Cobb, Coweta, Dawson, DeKalb, Douglas, Fayette, Floyd, Forsyth, Fulton, Gordon, Gwinnett, Hall, Haralson, Heard, Henry, Jackson, Jasper, Jones, Lamar, Lumpkin, Madison, Meriwether, Monroe, Morgan, Newton, Oconee, Paulding, Pickens, Pike, Polk, Putnam, Rockdale, Spalding, Troup, Upson, and Walton where such generators operate less than 200 hours-per-year);
- Stationary engines used for other purposes provided the total horsepower for all engines does not exceed 1,500 horsepower for non-gasoline engines and 225 horsepower for gasoline engines and no individual engine operates for more than 1000 hours...;
- Cumulative modifications not covered in an existing permit to an existing permitted facility where the combined emission increases (excluding any contemporaneous emission decreases, i.e., “netting” is not allowed) from all nonexempt modified activities are below the following thresholds for all pollutants:
  - 25 tons per year of CO;
  - 150 pounds-per-year total with a 1.5 pound-per-day maximum emission of lead;
  - 10 tons per year of PM<sub>10</sub> or SO<sub>2</sub>;
  - 10 tons per year of NO<sub>2</sub> or volatile organic compounds (VOCs) except in the counties where less than 2.5 tons per year of NO<sub>2</sub> or VOCs is exempted; and
  - 2 tons per year total with a 15 pound per day maximum emission of any single HAP and less than 5 tons per year of any combination of HAPs....
- Temporary stationary engines used to generate electricity that are used to replace main stationary engines during periods of maintenance or repair (provided the actual and potential emissions of the temporary sources do not exceed that of the main sources);
  - Facilities where the combined emissions from all non-exempt source activities are below the following for all pollutants:
    - 50 tons per year of CO;
    - 300 pounds per year of lead total; with a 3.0 pound per day maximum emission;
    - 20 tons per year of PM<sub>10</sub> or SO<sub>2</sub>;
    - 20 tons per year of NO<sub>2</sub> or VOCs except in the counties where less than 5 tons per year of NO<sub>2</sub> or VOCs is exempted; and

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<sup>142</sup> Emergency generator: “a generator whose function is to provide back-up power when electric power from the local utility is interrupted and which operates for less than 500 hours-per-year, except in certain counties where such generator operates less than 200 hours-per-year” (GA R&R, 2015b).

- 2 tons per year total with a 15 pound per day maximum emission of any single HAP and less than 5 tons per year of any combination of HAPs.” (GA R&R, 2015b)

### **Temporary Emissions Sources Permits**

Georgia can issue temporary permits for emissions from similar operations by the same source owner or operator at multiple temporary locations. Rule 391-3-1-.03(10)(d)5 [Permit Content] states, “The operation must be temporary and involve at least one change of location during the term of the permit. No affected source<sup>143</sup> may be permitted as a temporary source.” (GA R&R, 2015b)

### **State Preconstruction Permits**

Georgia’s Rule 391-3-1.03(1)(a) states “Any person prior to beginning the construction or modification of any facility which may result in air pollution shall obtain a permit for the construction or modification of such facility from the Director.” Construction permits are required under Rule 391-3-1-.03 [Permits Amended] prior to beginning any construction or modification to facility that may result in air pollution or a violation of the NAAQS. (GA R&R, 2015b)

### **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 SIP (USEPA, 2013c). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), federal actions “in response to emergencies which are typically commenced on the order of hours or days after the emergency” and actions “which are part of part of a continuing response to emergency or disaster” that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (GPO, 2010).

The estimated pollutant emissions are compared to *de minimis*<sup>144</sup> levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 6.1.12-3).

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<sup>143</sup> Affected source: “A source that includes one or more affected units that are subject to emission reduction requirements or limitations under Title IV [The Acid Rain Program] of the CAA” (GA R&R, 2015b).

<sup>144</sup> *de minimis*: USEPA states that “40 CFR 93 § 153 defines *de minimis* levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas” (USEPA, 2016f).

**Table 6.1.12-3: *De Minimis* Levels**

Pollutant	Area Type	TPY
Ozone (VOC or NO <sub>x</sub> )	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an Ozone Transport Region (OTR)	100
Ozone (NO <sub>x</sub> )	Maintenance	100
Ozone (VOC)	Maintenance outside an OTR	100
CO, SO <sub>2</sub> , NO <sub>2</sub>	All Nonattainment and Maintenance	100
PM <sub>10</sub>	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
PM <sub>2.5</sub> (Direct Emissions) (SO <sub>2</sub> ) (NO <sub>x</sub> (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (GPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 6.1.12-3, 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 6.1.12-3, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS (USEPA, 2010). To demonstrate conformity,<sup>145</sup> the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state’s SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS. (USEPA, 2010)

<sup>145</sup> Conformity: Compliance with the State Implementation Plan.

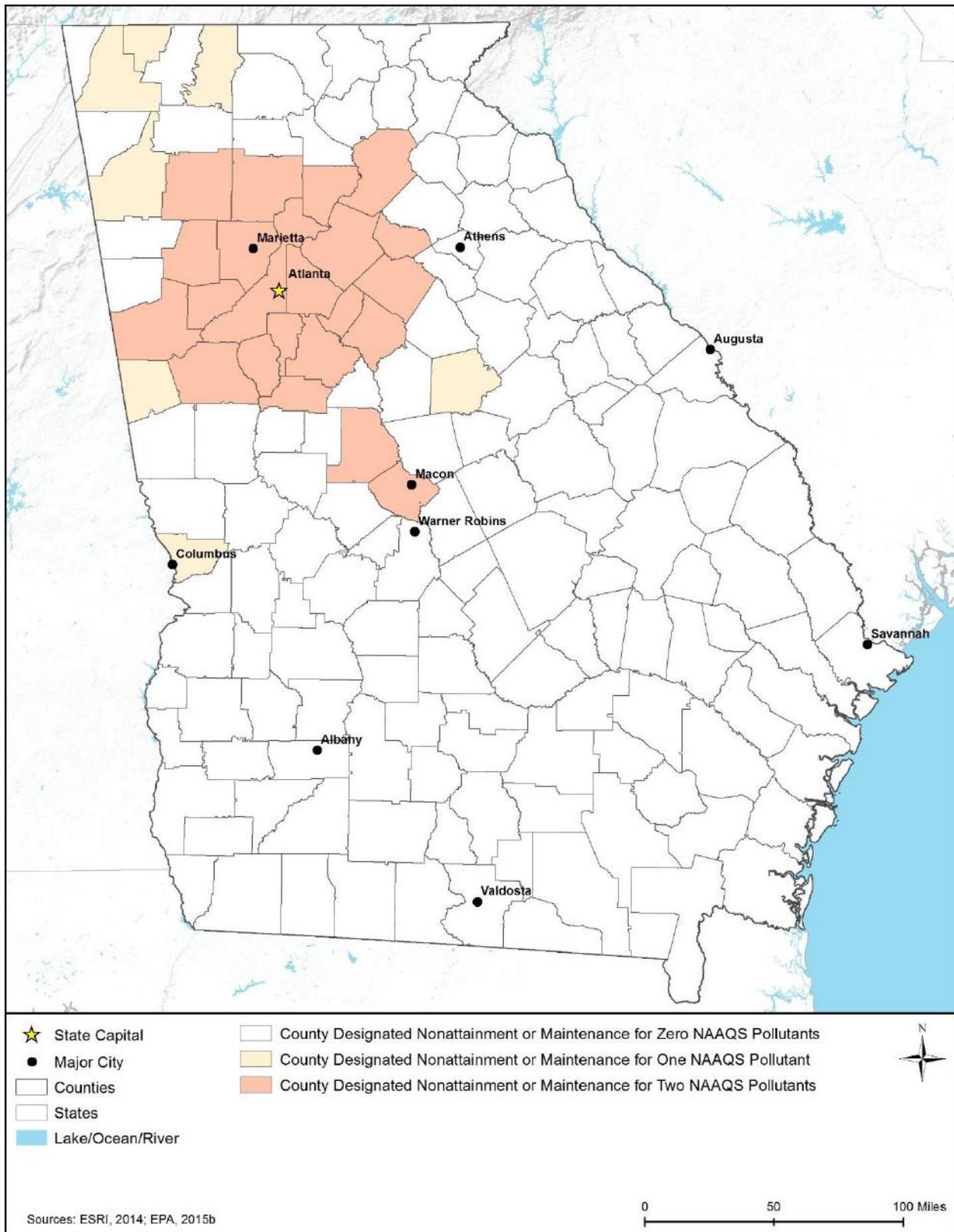
## State Implementation Plan Requirements

The Georgia SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Georgia's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Georgia's SIP actions are codified under 40 CFR Part 52 Subpart L. A list of all SIP requirements for designated areas for all six criteria pollutants can be found on the USEPA's website at [https://www3.epa.gov/airquality/urbanair/sipstatus/reports/ga\\_areabypoll.html](https://www3.epa.gov/airquality/urbanair/sipstatus/reports/ga_areabypoll.html).

### *6.1.12.3. Environmental Setting: Ambient Air Quality*

#### **Nonattainment Areas**

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas (USEPA, 2016g). Figure 6.1.12-1 and Table 6.1.12-4, present the nonattainment areas in Georgia as of January 30, 2015. The year(s) listed in the table for each pollutant indicate when USEPA promulgated the standard for that pollutant; note that, for PM<sub>2.5</sub>, O<sub>3</sub>, and lead, these standards listed are in effect. Table 6.1.12-4 contains a list of the counties and their respective current nonattainment status of each criteria pollutant. Note certain pollutants have more than one standard in effect (e.g., lead, PM<sub>2.5</sub>, O<sub>3</sub>, and SO<sub>2</sub>). Unlike Table 6.1.12-4, Figure 6.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM<sub>10</sub> and PM<sub>2.5</sub> merge in the figure to count as a single pollutant.



**Figure 6.1.12-1: Nonattainment and Maintenance Counties in Georgia**

**Table 6.1.12-4: Georgia Nonattainment and Maintenance Areas by Pollutant Standard and County**

County	Pollutant and Year USEPA Implemented Standard											
	CO		Lead		NO <sub>2</sub>	PM <sub>10</sub>	PM <sub>2.5</sub>		O <sub>3</sub>		SO <sub>2</sub>	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010	
Barrow						X-4		M				
Bartow						X-4		M	X-5			
Bibb						M		M				
Carroll						X-4		M				
Catoosa (Chattanooga, TN-GA-AL (GA portion))						M						
Cherokee						X-4		M	X-5			
Clayton						X-4		M	X-5			
Cobb						X-4		M	X-5			
Coweta						X-4		M	X-5			
De Kalb						X-4		M	X-5			
Douglas						X-4		M	X-5			
Fayette						X-4		M	X-5			
Floyd						M						
Forsyth						X-4		M	X-5			
Fulton						X-4		M	X-5			
Gwinnett						X-4		M	X-5			
Hall						X-4		M				
Heard						X-4						
Henry						X-4		M	X-5			
Monroe						M		M				
Murray								M				
Muscogee		M										
Newton						X-4		M	X-5			
Paulding						X-4		M	X-5			
Putnam						X-4						
Rockdale						X-4		M	X-5			
Spalding						X-4		M				
Walker (Chattanooga, TN-GA-AL (GA portion))						M						
Walton						X-4		M				

Source: (USEPA, 2017c)

- X-1 = Nonattainment Area (Extreme)
- X-2 = Nonattainment Area (Severe)
- X-3 = Nonattainment Area (Serious)
- X-4 = Nonattainment Area (Moderate)
- X-5 = Nonattainment Area (Marginal)
- X-6 = Nonattainment Area (Unclassified)
- M = Maintenance Area

## Air Quality Monitoring and Reporting

The GADNR measures air pollutants at 41 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (GADNR, 2015aa). Annual Georgia State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region (GADNR, 2015ab). The GADNR reports real-time pollution levels of O<sub>3</sub>, SO<sub>2</sub>, CO, NO<sub>2</sub>, PM<sub>2.5</sub>, and PM<sub>10</sub> on their website at <http://amp.georgiaair.org/>.

Throughout 2014, O<sub>3</sub> measurements exceeded the federal standard of 0.075 ppm eight times in Atlanta. SO<sub>2</sub> measurements exceeded the federal standard of 0.075 ppm three times in south Central Georgia. Measurements for PM<sub>2.5</sub> exceeded the federal standards of 35 µg/m<sup>3</sup> once in Columbus, Macon, and south Coastal Georgia (GADNR, 2015ac).

## 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. § 7470).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers<sup>146</sup> of a Class I area. “The USEPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

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 USEPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 50 kilometers<sup>147</sup> (the normal useful range of USEPA-approved Gaussian plume models)” (USEPA, 1992a). If an action is considered major

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<sup>146</sup> The memorandum and associated guidance use kilometers; 100 kilometers is equal to about 62 miles.

<sup>147</sup> The memorandum and associated guidance use kilometers; 50 kilometers is equal to about 31 miles.

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, 1992b).

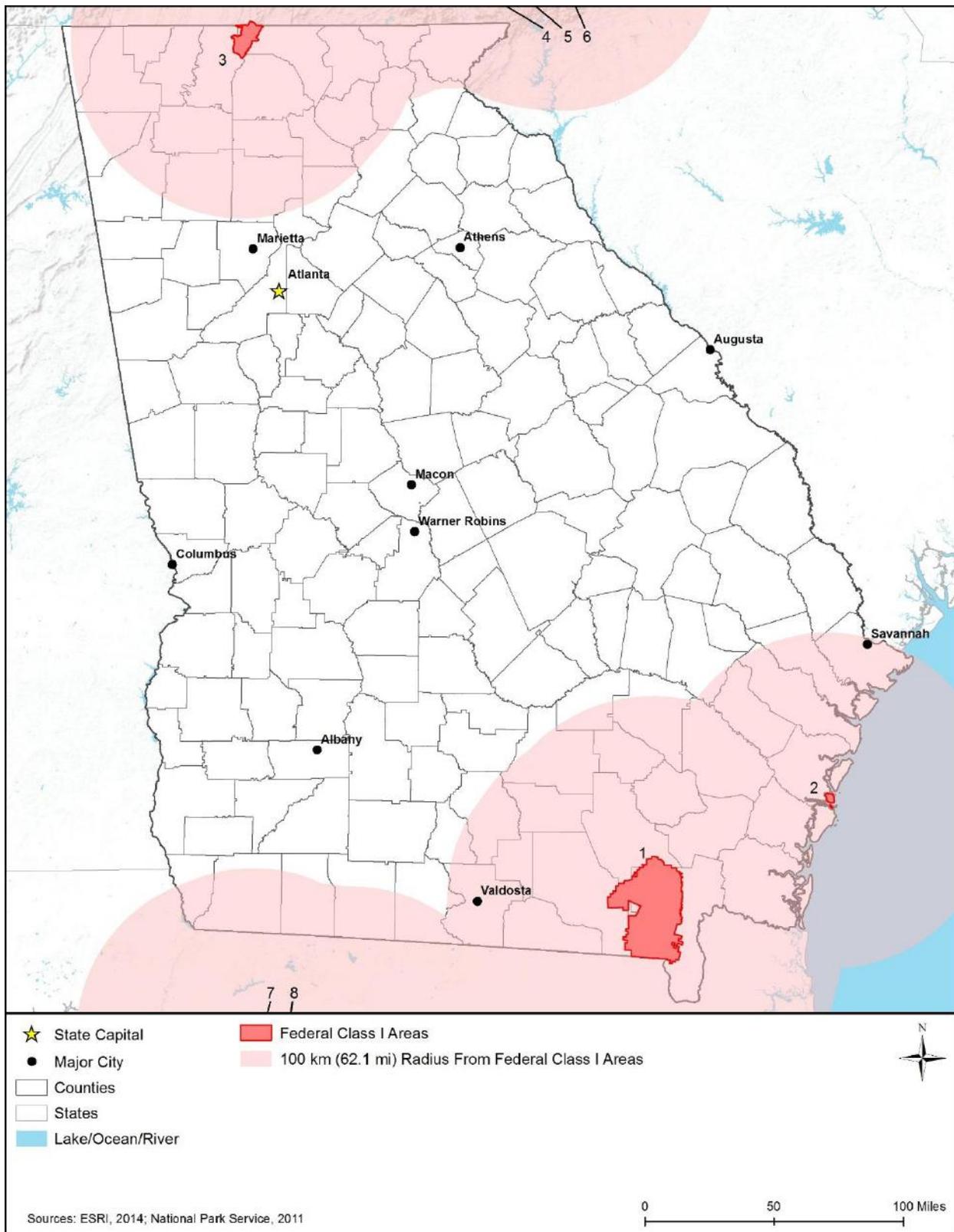
Georgia has three Class I areas: the Okefenokee Wilderness, Wolf Island Wilderness, and Cohutta Wilderness areas. Florida has two Class I areas, the Bradwell Bay Wilderness and Saint Marks Wilderness areas, where the 100-kilometer buffer intersects Georgia counties. North Carolina has three Class I areas, the Joyce Kilmer-Slickrock Wilderness, Great Smoky Mountains National Park, and Shining Rock Wilderness areas, where the 100-kilometer buffer intersects Georgia counties. Tennessee has three Class I areas, the Cohutta Wilderness, Joyce Kilmer-Slickrock Wilderness, and Great Smoky Mountains National Park areas, where the 100-kilometer buffer intersects Georgia counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office (USEPA, 2012b). Figure 6.1.12-2 provides a map of Georgia 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 6.1.12-2 correspond to the numbers and Class I areas listed in Table 6.1.12-5.

**Table 6.1.12-5: Relevant Federal Class I Areas**

# <sup>a</sup>	Area	Acreage	State
1	Okefenokee Wilderness	343,850	GA
2	Wolf Island Wilderness	5,126	GA
3	Cohutta Wilderness	37,000	GA, TN
4	Joyce Kilmer-Slickrock Wilderness	14,033	TN, NC
5	Great Smoky Mountains NP	514,758	TN, NC
6	Shining Rock Wilderness	13,350	NC
7	Bradwell Bay Wilderness	24,602	FL
8	Saint Marks Wilderness	17,745	FL

Source: (USEPA, 2012b), (USFS, 2015c)

<sup>a</sup> The numbers correspond to the shaded regions in Figure 6.1.12-2.



**Figure 6.1.12-2: Federal Class I Areas with Implications for Georgia**

### 6.1.13. Noise and Vibration

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

#### 6.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2017d). 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 and vibration 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.

Ground-borne vibrations, which in many instances can be caused by tools or equipment that generate noise, can also result from roadway traffic, rail traffic, and industrial activities as well as from some construction-related activities such as blasting, pile-driving, vibratory compaction, demolition, and drilling. Unlike noise, most ground-borne vibrations are not typically experienced every day by most people because the existing environment does not include a significant number of perceptible ground-borne vibration events.

#### Fundamentals of Noise and Vibration

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016a). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015h). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016a).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (FTA, 2006):

- The total sound energy radiated by a source, usually reported as a sound power level;
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (SPL) (the frequency characteristics and SPL combine to determine the loudness of a sound at a particular location);
- The duration of a sound; and
- The changes in frequency characteristics or pressure levels through time.

Figure 6.1.13-1 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.



Source: (Sacramento County Airport System, 2015)

Prepared by: Booz Allen Hamilton

Leq: Equivalent Continuous Sound Level

**Figure 6.1.13-1: Sound Levels of Typical Sounds**

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (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 (FTA, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causes an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably depending on whether environment is urban, suburban, or rural.

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Depending on the intensity, vibrations may create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 6.1.13-1 lists vibration source levels produced by typical construction machinery and activities at a distance of 25 feet in units of vibration decibels (VdB). The vibration thresholds for human perceptibility and potential building damage are 65 and 100 VdB, respectively (FTA, 2006).

**Table 6.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)**

Equipment <sup>a</sup>	VdB <sup>b</sup> at 25 feet away
Pile Driver (impact type)	104-112
Pile Driver (sonic or vibratory type)	93-105
Vibratory Roller	94
Hoe Ram	87
Large Bulldozer	87
Caisson Drilling	87
Loaded Trucks	86
Jackhammer	79
Small Bulldozer	58

Source: (FTA, 2006)

<sup>a</sup> The types of equipment listed in this table are included for reference purposes only. It is possible that not all equipment types listed here would be used in the deployment and operation of the Proposed Action.

<sup>b</sup> VdB = vibration decibels

### **6.1.13.2. Specific Regulatory Considerations**

As identified in Appendix C, Environmental Laws and Regulations, the Noise Control Act of 1972, along with its subsequent amendments (e.g., Quiet Communities Act of 1978 [42 U.S.C. Parts 4901–4918]), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Although no federal noise regulations exist, the USEPA has promulgated noise guidelines (USEPA, 1974). Similarly, most states have no quantitative noise limit regulations.

Georgia does not have a state-wide noise regulation that would apply to activities covered under the Proposed Action. However, many cities and towns may have local noise ordinances to manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Atlanta (and surrounding communities), Augusta, Columbus, Macon, and

Savannah, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011).

### **6.1.13.3. Environmental Setting: Ambient Noise**

The range and level of ambient noise in Georgia varies widely based on the area and environment of the area. The population of Georgia can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 6.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Georgia may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Georgia. As such, this section describes the areas where the population of Georgia 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) (USDOJ, 2008). The areas that are likely to have the highest ambient noise levels in the state are Atlanta (and surrounding cities and towns), Augusta, Columbus, Macon, and Savannah.
- **Airports:** Areas surrounding airports tend to be more sensitive to noise due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2015h). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending on the type of aircraft and associated engine (FAA, 2012a). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports are in the proximity of urban communities; therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Georgia, Hartsfield-Jackson Atlanta International Airport (ATL) is a major airline hub, and combined with Savannah/Hilton Head International Airport (SAV), these two airports have more than 944,000 annual operations combined (FAA, 2015i). These operations result in increased ambient noise levels in the surrounding communities. See Section 6.1.1, Public Safety Infrastructure 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 (FHWA, 2015e). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living in those areas. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015e). See Section 6.1.1, Infrastructure for more information about the major highways in the state.

- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015). Georgia has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend from Atlanta to other cities in Georgia, Florida, Alabama, Tennessee, and South Carolina, which are primarily owned by the Norfolk Southern Railway and CSX Transportation (GADOT, 2015b). There are also a number of other rail corridors that join these major rail lines and connect with other cities (GADOT, 2015e). See Section 6.1.1, Infrastructure for more information about rail corridors in the state.
- **National and State Parks:** The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National and state parks, historic areas, and monuments are protected areas. These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014b). Georgia has 11 NPS units and 11 National Natural Landmarks (NPS, 2015p) (NPS, 2012c). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 6.1.7, Visual Resources for more information about national and state parks for Georgia.

#### ***6.1.13.4. Sensitive Noise and Vibration Receptors***

Noise and vibration-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise and vibration receptors are typically areas where the intrusion of noise and vibrations 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 and towns in Georgia have at least one school, church, or park, in addition to likely having other noise and vibration-sensitive receptors. There are most likely thousands of sensitive receptors in Georgia.

### **6.1.14. Climate Change**

#### ***6.1.14.1. 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." (De-Campos, Mamedov, & Huang, 2009)

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<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (De-Campos, Mamedov, & Huang,

2009). The common unit of measurement for GHGs is metric tons of CO<sub>2</sub>-equivalent (MT CO<sub>2</sub>e),<sup>148</sup> which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO<sub>2</sub> only, the units are in million metric tons (MMT) CO<sub>2</sub>. Where the document references emissions of multiple GHGs, the units are in MMT CO<sub>2</sub>e.

“Global concentrations of these four GHGs have increased significantly since 1750” (IPCC, 2007). “Atmospheric concentrations of CO<sub>2</sub> increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005” (IPCC, 2007). The atmospheric concentration of CH<sub>4</sub> has increased from a pre-industrial value of about 715 parts per billion (ppb) to 1774 ppb in 2005. (IPCC, 2007) “Atmospheric concentrations of N<sub>2</sub>O increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005” (IPCC, 2007). “Many halocarbons have increased from a near-zero pre-industrial concentrations, primarily due to human activities” (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, will be considered in this PEIS (see Section 6.2.14, Environmental Consequences). Therefore, to form the baseline against which to assess possible impacts from the Proposed Action, the existing climate conditions in the project area will be described first by state and sub-region, where appropriate, and then future projected climate scenarios will be described by state and sub-region. The discussion will focus on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events (including tropical storms, tropical cyclones, and hurricanes).

#### **6.1.14.2. Specific Regulatory Considerations**

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C, Environmental Laws and Regulations. The Council on Environmental Quality (CEQ) published draft National Environmental Policy Act (NEPA) guidance on the consideration of the effects of climate change and greenhouse gas in February of 2010. Revised draft guidance was published in December 2014 and in August 2016 (after publication of the Draft PEIS) CEQ published its final guidance. This guidance is applicable to all federal agency actions and is meant to facilitate compliance within the legal requirements of NEPA. The CEQ guidance describes how federal agency actions should evaluate GHG and climate change effects in their NEPA reviews, using GHG emissions as a proxy for assessing a proposed action’s potential effect on climate change. CEQ defines GHGs to include CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with Section 19 (m) of *Executive Order 13693*. The final CEQ guidance suggests that agencies consider “(1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g. to include, where applicable, carbon sequestration); and (2) the effects of climate change on a proposed action and its environmental impacts.” The final

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<sup>148</sup> CO<sub>2</sub>e 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 (MMT CO<sub>2</sub>e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMT CO<sub>2</sub>e = (million metric tons of a gas) \* (GWP of the gas)” (USEPA, 2016a).

guidance recommends that agencies quantify an action’s projected direct and indirect GHG emissions when data inputs are reasonably available to support calculations. The final guidance states that “agencies should be guided by the principle that the extent of the analysis should be commensurate with the quantity of the projected GHG emissions and take into account available data and GHG quantification tools that are suitable for and commensurate with the proposed agency action.” In addition, CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action’s potential climate change impacts. The analysis should assess direct and indirect climate change effects of a proposed project including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future.

The state of Georgia has not established goals and regulations to reduce GHG emissions to combat climate change. However, as shown in Table 6.1.14-1, Atlanta, Georgia has developed goals for climate change preparedness and GHG emissions.

**Table 6.1.14-1: Relevant Georgia Climate Change Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Atlanta Climate Action Plan	City of Atlanta, Georgia	Atlanta has created a draft Climate Action Plan, which creates a clear course of action so that everyone can have a role in creating and achieving climate and sustainability goals, with efforts toward a reduction in GHG emissions by: <ul style="list-style-type: none"> <li>• 20 percent below 2009 levels by 2020; and</li> <li>• 40 percent below 2009 levels by 2030.</li> </ul>

Source: (City of Atlanta Climate Action Plan, 2015)

**6.1.14.3. Georgia Greenhouse Gas Emissions**

Estimates of Georgia’s total GHG emissions vary. The Department of Energy’s (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as CH<sub>4</sub> and nitrous oxide (NO<sub>x</sub>), but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2016h). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHGs in a variety of ways.

For the purposes of this PEIS, the EIA data on CO<sub>2</sub> 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<sub>4</sub>, they are described and cited.

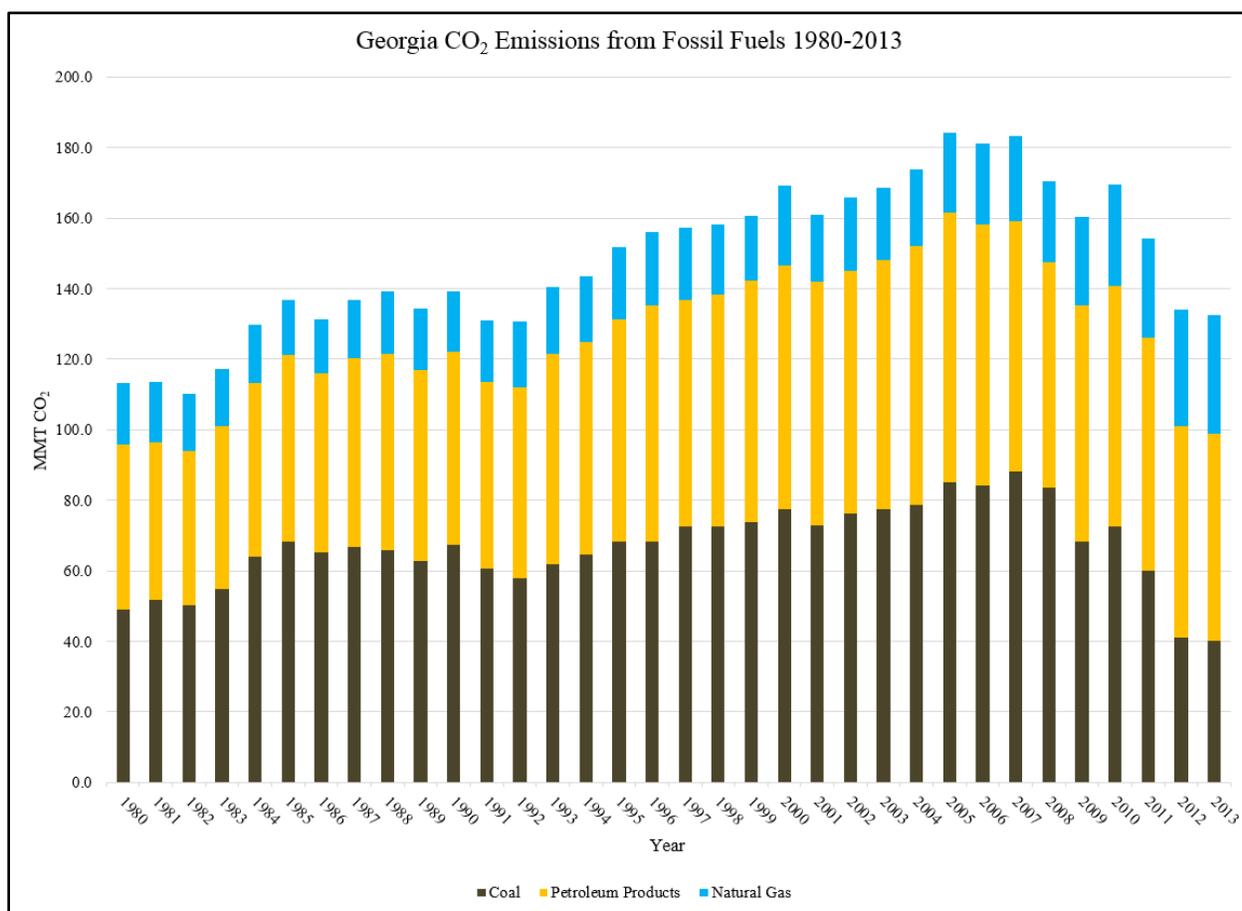
According to the EIA, Georgia emitted a total of 140.0 MMT of CO<sub>2</sub> from fossil fuels in 2014 (EIA, 2014b). CO<sub>2</sub> were roughly split between transportation (approximately 38 percent) and electric power (approximately 42 percent) sectors. Almost all of the emissions from coal are

produced by the electric power sector, which also accounts for almost half of the emissions from natural gas. The transportation sector accounts for most of the petroleum emissions (shown in Table 6.1.14-2) (EIA, 2014b). Annual emissions between 1980 and 2012 are presented in Figure 6.1.14-1 (EIA, 2014b). Georgia was ranked 11<sup>th</sup> among the states and the District of Columbia for total CO<sub>2</sub> emissions in 2014 and was ranked 31<sup>nd</sup> for per capita CO<sub>2</sub> emissions in 2014 (EIA, 2017b).

**Table 6.1.14-2: Georgia CO<sub>2</sub> Emissions from Fossil Fuels by Fuel Type and Sector, 2014**

Fuel Type (MMT)		Source (MMT)	
Coal	45.6	Residential	7.8
Petroleum Products	59.0	Commercial	4.1
Natural Gas	35.5	Industrial	14.8
		Transportation	53.8
		Electric Power	59.5
<b>TOTAL</b>	<b>140</b>	<b>TOTAL</b>	<b>140</b>

Source: (EIA, 2014b)



Source: (EIA, 2014b)

**Figure 6.1.14-1: Georgia CO<sub>2</sub> Emissions from Fossil Fuels by Fuel Type 1980-2013**

In 2008, the GADNR prepared a 1990 – 2008 greenhouse gas emission inventory for the state of Georgia (State of Georgia, 2012c). The report estimates that GHG emissions increased from approximately 144.2 MMT CO<sub>2</sub>e in 1991 to approximately 201.4 MMT CO<sub>2</sub>e in 2007. For comparison, total U.S. GHG emissions were estimated to be 6,397 MMT CO<sub>2</sub>e in 1990, 7,4221 MMT CO<sub>2</sub>e in 2007, and 6,870 million metric tons in 2014 (USEPA, 2014e).

Gross GHG emissions in Georgia (total emissions, not accounting for carbon sequestration in soils and forests) increased by 25 percent between 1990 and 2008. Emissions from methane and N<sub>2</sub>O peaked in 1996 and have generally decrease annually. Hydrofluorocarbons (HFC), perfluorinated chemicals (PFC), and sulfur hexafluoride (SF<sub>6</sub>) emissions are attributed to industrial processes and have increased since 1990 (State of Georgia, 2012c). The majority of Georgia’s GHG emissions are CO<sub>2</sub>. These emissions are the result of fossil fuel combustion for producing energy, mostly petroleum products from electric power generating facilities and coal-fired power plants (State of Georgia, 2012c).

Georgia does not produce crude oil, natural gas or coal, instead receives these resources by rail, petroleum product pipelines and interstate pipelines. Liquefied natural gas is often imported from other countries such as Qatar and Egypt. Two nuclear power plants in Georgia provide one-fourth of its electricity (EIA, 2015c), helping to keep its per-capita CO<sub>2</sub> emissions lower than they would be with fossil fuel plants. Georgia is a large producer of hydroelectric power and currently has thousands of dams. It is also a major consumer of energy from biomass (EIA, 2015c).

#### **6.1.14.4. Environmental Setting: Existing Climate**

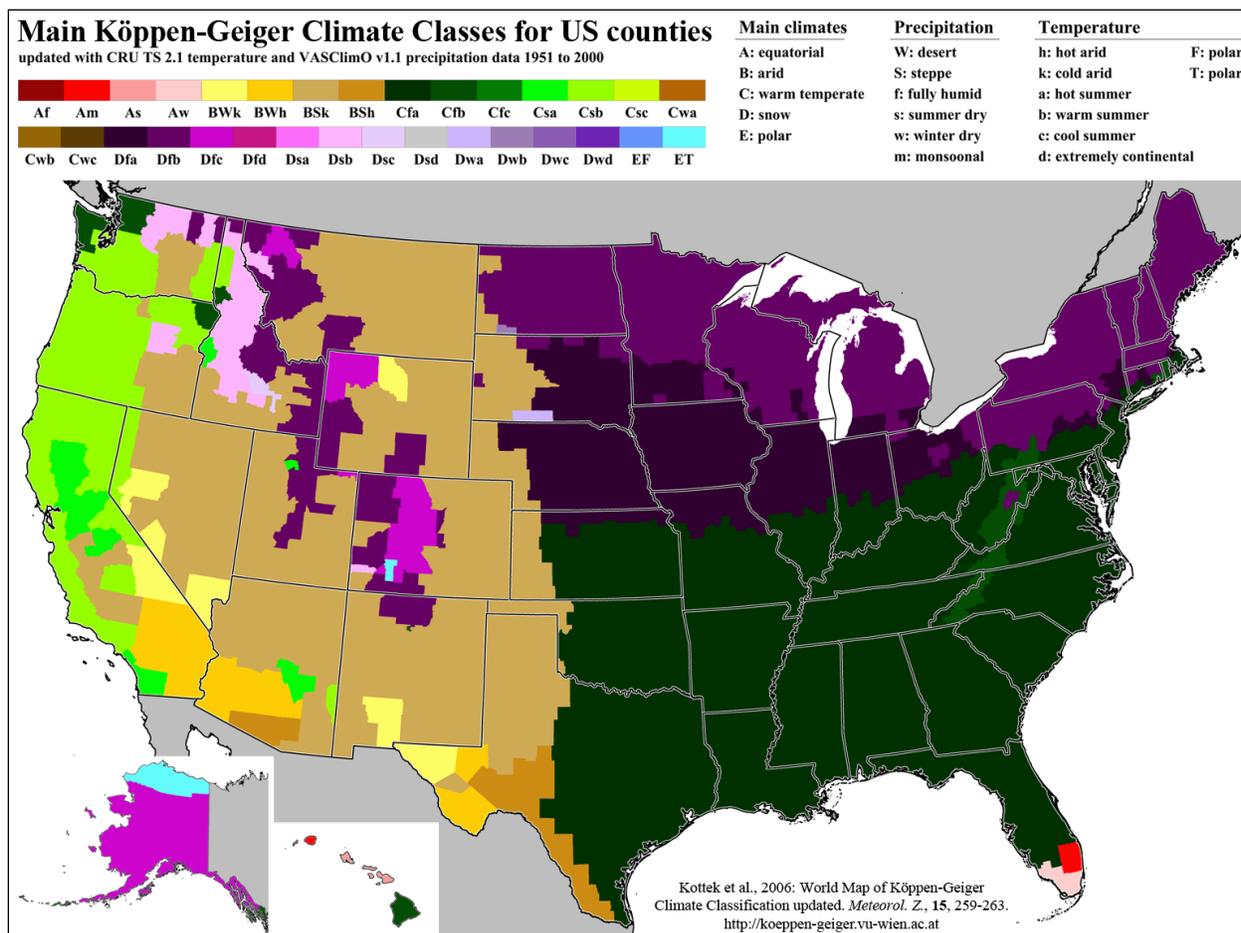
The National Weather Service defines climate as the “composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years” (NWS, 2009). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based “upon general temperature profiles related to latitude” (NWS, 2009). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2006).

The entirety of Georgia falls into climate group (C). Climates classified as (C) are warm, with humid summers and mild winters. During winter months, the main weather feature is the mid-latitude cyclone (NWS, 2009). During summer months, thunderstorms are frequent. Georgia has one sub-climate category, which is described in the following paragraphs (NPS, 2011b) (NWS, 2011).

Cfa – The Köppen-Geiger climate classification system classifies the entirety of Georgia 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. (NPS, 2011b) (NWS, 2011)

This section discusses the current state of Georgia’s climate with regard to air temperature, precipitation, sea level, and extreme weather events (e.g., tropical storms, tropical cyclones, flooding, tornadoes, and hurricanes) in the state’s climate zone, Cfa.



Source: (Kottek, 2006)

**Figure 6.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties**

### Air Temperature

Elevations in Georgia range from sea level along the coast of the Atlantic Ocean to a “peak height of 4,784 feet at Brasstown Bald in far northern Georgia in the southern Appalachian Mountains” (Knox, 2015). Georgia’s location in the southeastern U.S. and along the Atlantic Ocean “puts it in the path of many different types of weather systems, leading to a wide variation in weather across the year that is suitable for raising many different crops” (Knox, 2015).

Overall, Georgia experiences “warm, humid summers and short, mild winters” (GAEMC, 2012). “All four seasons are apparent, but spring is usually short with rather frequent periods of storminess of varying intensity” (GAEMC, 2012). During autumn months, “long periods of

mild, sunny weather are the norm” (GAEMC, 2012). The mean annual temperature in Georgia ranges from 54°F in northeast regions of the state, to 68°F in southern regions of the state. Temperatures during winter months, such as January, range from 36°F in northern regions, to 53°F in southern regions. During summer months, such as July, temperatures in the north range from 70°F, to 84°F in the south. (GAEMC, 2012)

Inland coastal plains and Piedmont areas “stretch from southwest to northeast” across central regions of the state (Knox, 2015). This area is the hottest region of the state during summer months, with temperatures commonly reaching 100°F or higher (Knox, 2015). During summer months, Macon, located along the border of the coastal plain and Piedmont area, has an average maximum temperature of approximately 76.3°F and an average minimum temperature of approximately 52.7°F (NOAA, 2015i).

Along Georgia’s coastline, temperatures are warm and humid for most of the year. On occasion, “cold temperatures and even snow will reach the coastal areas” (Knox, 2015). Savannah, located along Georgia’s coastline, has an average maximum temperature of approximately 75.6°F and an average minimum temperature of approximately 54.2°F during summer months (NOAA, 2015i). During winter months, Savannah has an average maximum temperature of approximately 60.5°F and an average minimum temperature of approximately 38.9°F during winter months (NOAA, 2015i).

The highest temperature to occur in Georgia was on July 24, 1952 and August 20, 1983 with a record 112°F (SCEC, 2015). The lowest temperature to occur in Georgia was on January 27, 1940 with a record low of negative 17°F (SCEC, 2015).

The following paragraphs describe annual temperatures as they occur in the various climate classification zones:

Cfa – Atlanta, the capital of Georgia, is located in northern Georgia and within the climate classification zone, Cfa. The average annual temperature in Atlanta is 62.6°F; 45.2°F during winter months; 79.0°F during summer months; 62.1°F during spring months; and 63.6°F during autumn months (NOAA, 2015j).

## **Precipitation**

Average rainfall in Georgia ranges from 45 inches in the south, to 80 inches in the northeast. Inland coastal plains and the Piedmont areas “stretch from southwest to northeast” across central regions of the state (Knox, 2015). This area is the driest region of Georgia, with some areas receiving less than 45 inches per year. The northeast region of Georgia receives the most rainfall, with approximately 80 inches on average per year (GAEMC, 2012) (Knox, 2015).

The influence of the Atlantic Ocean can also be seen in “the development of thunderstorms and showers near the coast as the sea breeze develops over the day” (Knox, 2015). During Georgia’s tropical storm season, between June and November, hurricanes and tropical storms contribute “copious rainfall amounts as they pass through the area” (Knox, 2015). Georgia’s driest season is autumn, followed closely by the month of May (GAEMC, 2012). October is typically the driest month, except in “the southeast where November is usually drier” (GAEMC, 2012). The

greatest 24-hour precipitation accumulation occurred on July 6, 1994 with a total of 21.1 inches, in Americus (SCEC, 2015).

Statewide, Georgia receives less than three inches of snow per year (GAEMC, 2012). In northern regions of the state, snow and icfall can be heavy. However, the southern region of the state does not experience snow. The greatest 24-hour snowfall accumulation occurred on March 3, 1942 with a total of 19.3 inches, in Cedartown (SCEC, 2015) (GAEMC, 2012).

Cfa – Atlanta, the capital of Georgia, is located in northern Georgia and within the climate classification zone, Cfa. The average annual precipitation accumulation in Atlanta is 49.71 inches; 12.77 inches during winter months; 13.12 inches during summer months; 11.84 inches during spring months; and 11.98 inches during autumn months (NOAA, 2015j).

### **Sea Level**

Georgia has approximately 100 miles of coastline and 2,344 miles of shoreline mileage<sup>149</sup> (NOAA, 2015k). Georgia's coastal zone "includes 11 counties that border tidally influenced waters or have economies that are closely tied to coastal resources" (NOAA, 2012a). Much of this shoreline is at risk for damage from strong winds, heavy rainfall, flooding, and hurricanes. Since 1900, sea level along Georgia's coastline has risen approximately one foot (measured at Fort Pulaski in Savannah), with a rise of approximately 3 millimeters per year (Georgia Conservancy, 2015) (University of Georgia, 2015b). As sea level continues to rise, the risks associated with living along the coast also rise. The majority of Georgia's shoreline "lies just a few feet above sea level, putting barrier islands and coastal communities at risk for more frequent flooding, intensified storm surges, and saltwater intrusion into low-lying areas" (University of Georgia, 2015b). Superstorm Sandy in 2012 highlighted the risks and vulnerabilities of living near unprotected tidal shoreline.

### **Severe Weather Events**

In Georgia, the most common forms of severe weather include severe flooding, hail, strong winds, hurricanes, tropical storms, tornadoes, and ice storms.

Although Georgia has not experienced a "direct hit by a hurricane since 1900," three major hurricanes occurred in the 1800s, "so the likelihood of an eventual direct landfall is high" (Knox, 2015). However, it is important to note, that even "when the eye of the storm does not come onshore," significant and destructive flooding can occur throughout coastal and inland areas (Knox, 2015). The last hurricane to make landfall was Hurricane David, "a Category 1 hurricane, in 1979" (GAEMC, 2012). Four hurricanes have made landfall in Georgia since 1900 (1911, 1940, 1947, and 1979). In addition to coastal flooding, Georgia is susceptible to riverine and flash flooding. Due to steep mountain valley slopes, "flash floods sometimes occur in the summer months when thunderstorms develop over the mountainous areas and inundate local rivers with several inches of rain in just a few hours" (Knox, 2015) (GAEMC, 2012).

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<sup>149</sup> Shoreline Mileage of outer coast, offshore islands, sounds, bays, rivers, and creeks is included to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet.

One of the most costly, widespread, and damaging floods occurred due to excessive and heavy rainfall in the Atlanta Metro Area and northwest Georgia in September 2009. This flood “brought the highest levels ever recorded at many United States Geological Survey (USGS) stream gauges across the region” (USGS, 2015n). The Chattahoochee River Basin was one of the areas most affected, with flood stage reaching 28.12 feet, “the highest stage in 81 years of continuous record at the gauge” (USGS, 2015n). North of Atlanta, Lake Sidney Lanier “rose almost 4 feet in a 48-hour period following the storm” (USGS, 2015n). Lake Sidney Lanier “is credited with preventing record flood levels in Atlanta” (USGS, 2015n). Monetary losses from this flooding event reached approximately \$300 million in damages and resulted in eleven fatalities. In addition, 17 counties were declared federal disaster areas. (NWS, 2015a) (USGS, 2015n)

During another particularly damaging flood event, Tropical Storm Alberto in July of 1994 caused 33 fatalities (31 in Georgia and 2 in Alabama) and approximately \$750 million in damages across Georgia, Alabama, and Florida. In addition, 55 counties in Georgia were declared federal disaster areas. Central and southwestern Georgia were struck the hardest, with peak discharges exceeding the 100-year flood mark along most rivers and streams. (USGS, 1996)

Severe tornadoes are also frequent in Georgia, with an average of six tornadoes occurring per year. Although tornadoes have occurred during every month of the year, tornado season in Georgia is March through May, with the most likely time of occurrence being from mid-afternoon through early evening. The majority of tornadoes occur in northern and southwestern regions of the state (1950 to 2011). Worth County has experienced 31 tornadoes, the most of any other county in Georgia, followed closely by Colquitt County, with 30 tornadoes (1950 to 2011). Approximately 37 percent of all tornadoes that occur in Georgia reach F2 intensities or greater. “These strong tornadoes are more likely to take place in the month of April than in any other month” (GAEMC, 2012). Between 1991 and 2010, Georgia experienced 30 tornadoes. (GAEMC, 2012)

Thunderstorms in Georgia “can produce gusty winds, hail, and even tornadoes” (NWS, 2015b). Severe thunderstorms can produce hail and/or winds of 58 miles per hour (mph) or greater. Severe thunderstorms in Georgia last approximately 30 minutes, and typically occur in the afternoon and evening hours. “Supercells, a special class of thunderstorms, are particularly violent and can last for several hours” (NWS, 2015b). Supercell thunderstorms are most common during spring months, and frequently produce tornadoes. Local windstorms, commonly associated with thunderstorms, occur most frequently during spring and early summer months. (GAEMC, 2012)

Strong winds are the “most common type of severe weather across north and central Georgia” and occur an average of 19 days per year (GAEMC, 2012) (NWS, 2015b). Strong winds can occur at any time during the year, “but peak in July when downbursts from pulse thunderstorms are common” (NWS, 2015b). Between 1950 and 2010, 325 injuries and 18 fatalities have occurred across north and central Georgia due to severe winds. Since 1970, approximately 500

severe wind events have occurred, with the majority occurring during July. Wind damage most often occurs during the mid-afternoon through early evening. (GAEMC, 2012)

Georgia experiences hailstorms an average of seven days per year. Hailstorm events can also occur during any month across northern and central regions of Georgia, but peak in April and May, with storms occurring most frequently from mid-afternoon through early evening. The majority of hailstones are between 1 and 2 inches in diameter. The largest hailstones recorded in north Georgia were approximately 4.5 inches in diameter. (GAEMC, 2012) (NWS, 2015b)

## **6.1.15. Human Health and Safety**

### ***6.1.15.1. Definition of the Resource***

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the deployment, 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 deployment 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) emissions, addressed in Section 2.4, RF Emissions. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 6.1.1.

There are unique infectious diseases throughout the continental U.S. Because of the great variety of diseases, as well as the variables associated with contracting them, this PEIS will not be evaluating infectious diseases. For information on Infectious Diseases, please visit the Center for Disease Control and Prevention website at [www.CDC.gov](http://www.CDC.gov).

### ***6.1.15.2. Specific Regulatory Considerations***

Federal organizations, such as the Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services (DHHS), and others protect human health and the environment. In Georgia, this resource area is regulated by the Georgia Department of Labor (GADOL) and the GADNR, Environmental Protection Division (GAEPD). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Georgia does not have an OSHA-approved "State Plan," so private and public sector occupational safety and health programs in the state of Georgia are enforced by OSHA. Occupational and public health are further regulated by the Georgia Department of Public Health (GADPH).

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 6.1.15-1 below summarizes the major Georgia laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

**Table 6.1.15-1: Relevant Georgia Human Health and Safety Laws and Regulations**

State Law/Regulation	Regulatory Agency	Applicability
Georgia Rules and Regulations: Chapter 391-3-3	GAEPD	Provides rules and regulations regarding surface mining and reclamation of affected lands, pursuant to the Georgia Surface Mining Act of 1968.
Georgia Rules and Regulations: Chapter 391-3-2	GAEPD	Describes groundwater use regulations, permit requirements, and enforcement.

Source: (GA R&R, 2017d) (GA R&R, 2017e)

**6.1.15.3. 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 waterbodies, and on communication towers. Tasks may also be performed at dangerous heights or confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016b). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

*Working from height, overhead work, and slips, trips, or falls* – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground’s surface (OSHA, 2015). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (IFC, 2007).

*Trenches and confined spaces* – Installation of underground utilities, building foundations, and work in utility manholes<sup>150</sup> are examples of when confined space work is necessary. Installation of telecommunication activities involves laying conduit and in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker

<sup>150</sup> Manholes may be used for telecommunications activities, especially in cities and urban areas, depending on the location of other utilities. In cities, power, water, and telecommunication lines are often co-located; if access is through a manhole in the street, that access will be used.

movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016c)

*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 at telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator. (OSHA, 2016c)

*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. (IFC, 2007)

*Optical fiber safety* – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (IFC, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

*Noise and Vibrations*– Sources of excess noise and vibrations at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such as diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 6.1.13, Noise) (OSHA, 2002). Fugitive noise and vibrations may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area (OSHA, 2016c).

*Hazardous materials and hazardous waste* – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require treatments, such as pesticide application. Secondary hazardous materials, like exhaust fumes, may be a greater health risk than the primary hazardous material (i.e., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based (exterior and interior) paint at outdoor structures or asbestos tiles and insulation in equipment sheds. The 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. (OSHA, 2016c)

*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 operate heavy equipment from soft shorelines, boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016c)

*Outdoor elements* – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings. (OSHA, 2016c)

### **Telecommunication Worker Occupational Health and Safety**

The U.S. Department of Labor, 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 either 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).

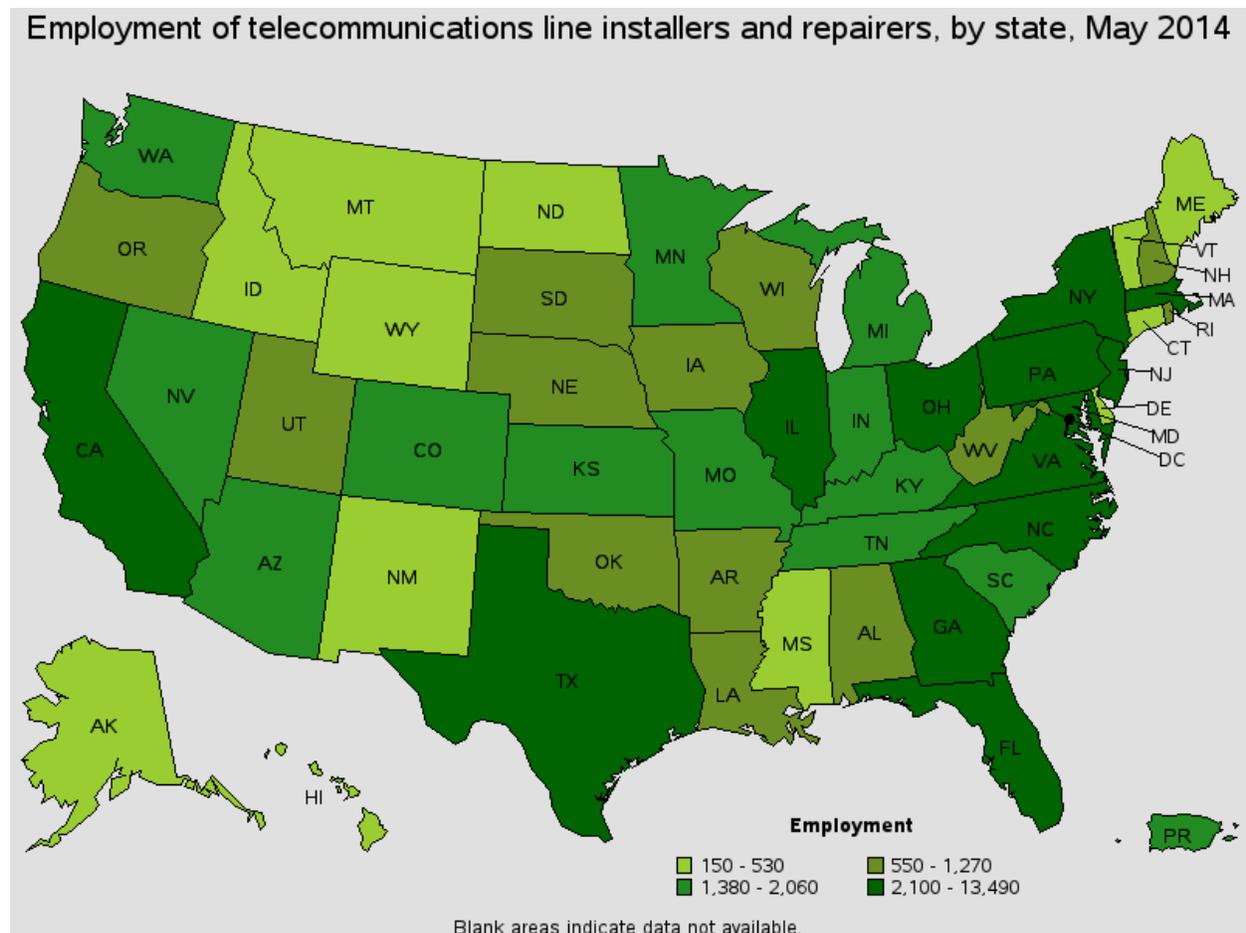
As of May 2014, there were 9,590 telecommunication equipment installers and repairers, and 2,100 telecommunication line installers and repairers (Figure 6.1.15-1) working in Georgia (BLS, 2015c). In 2013, the most recent year data are available, Georgia had 0.7 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013b).

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, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Since 2003, when data are first available, Georgia had one occupational fatality in the telecommunications equipment installers and repairers occupation (SOC code 49-2022) in 2014 (BLS, 2015d). By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-

0000), there were 153 fatalities in Georgia between 2003 and 2014, with the highest fatality years being 2004 and 2006, with 22 fatalities each (BLS, 2015d).

**Public Health and Safety**

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. GADPH collects mortality data among the general public through the Online Analytical Statistical Information System (OASIS). While OASIS cannot be searched for cases specific to telecommunication sites, many available external causes of death are consistent with potential risks present at telecommunication sites. For example, between 1994 and 2013, there were 9,959 fatalities due to falls, 2,226 fatalities from drowning, 2,529 fatalities from fire and smoke exposure, and 3,372 fatalities from suffocation (GADPH, Office of Health Indicators for Planning, 2015). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.



Source: (BLS, 2014a)

**Figure 6.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014**

#### **6.1.15.4. *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<sup>151</sup> or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

The Georgia Hazardous Waste Trust Fund, otherwise known as the state Superfund program, is used to pay for the cleanup of contaminated sites. Georgia's Land Protection Branch (LPB) also maintains a Hazardous Site Inventory (HSI) of sites that have had a release of a regulated substance above a reportable quantity (GAEPD, 2015f). As of October 2015, Georgia had 77 RCRA Corrective Action sites,<sup>152</sup> 135 brownfield sites, and 17 proposed or final Superfund/NPL sites (USEPA, 2015i). Based on an October 2015 search of USEPA Cleanups in My Community (CIMC) database, there is one Superfund site (Armstrong World Industries, Inc. in Macon, GA) where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists (USEPA, 2015j).

Brownfield sites in Georgia may enroll in the state Voluntary Remediation Program (VRP), which was created to encourage voluntary remediation of underutilized or abandoned contaminated properties (GAEPD, 2015g). One example is the Atlantic Station Redevelopment in Atlanta, GA. This brownfield site encompasses the former 138-acre Atlantic Steel Mill, which operated for nearly 100 years before closing in 1998. Cleanup activities removed 180,000 square yards of contaminated soil and installed a groundwater extraction system to prevent migration of vinyl chloride. The site was redeveloped into a mixed-use district, which brought residents, jobs, and commerce to the otherwise underutilized area (USEPA, 2007).

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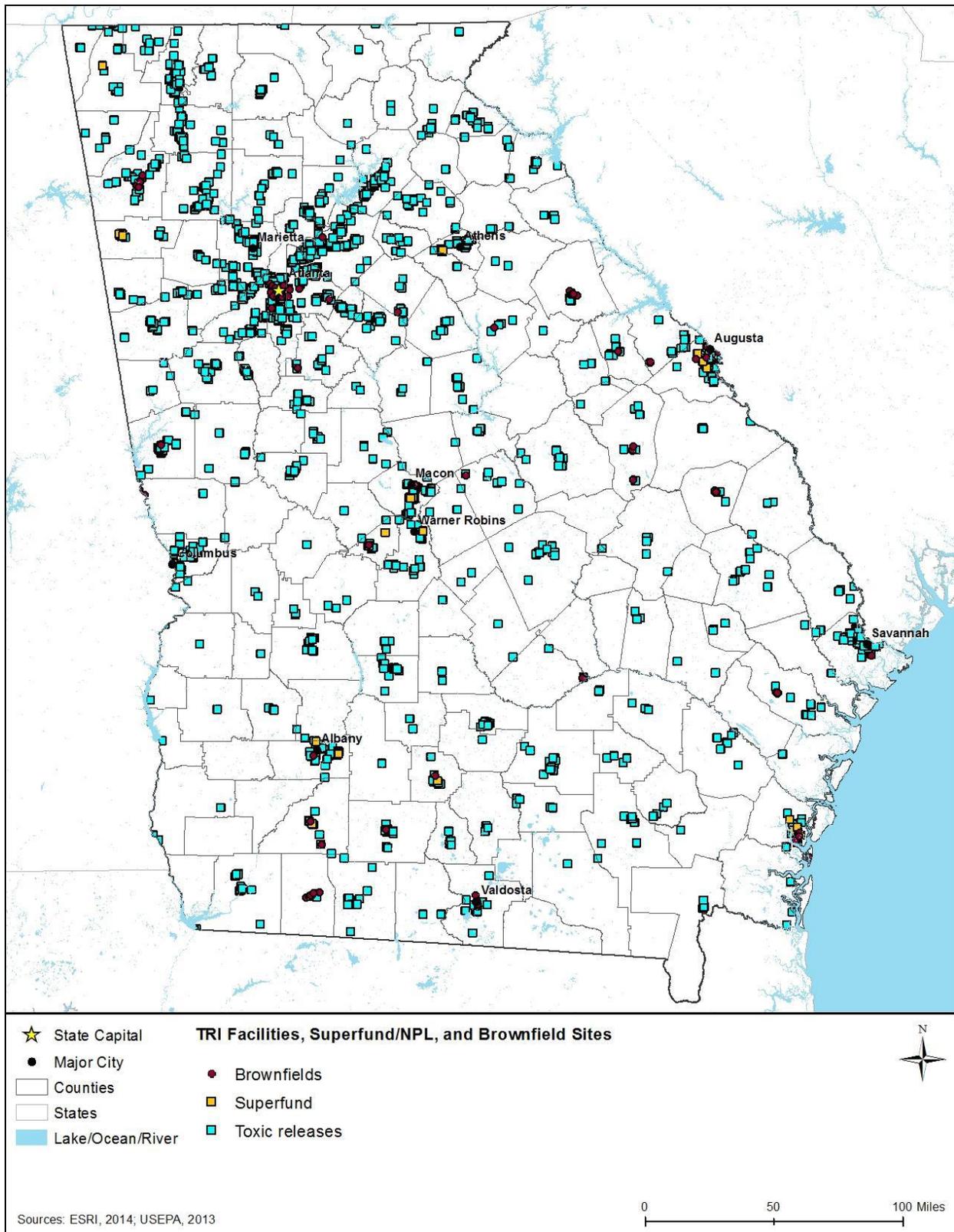
<sup>151</sup> The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), enacted in 1980, commonly referred to as the Superfund Program, governs abandoned hazardous waste sites, and collects a tax on chemical and petroleum industries. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986; see Appendix C, Environmental Laws and Regulations (USEPA, 2011).

<sup>152</sup> Data gathered using USEPA's CIMC search on October 14, 2015, for all sites in Georgia, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active). (USEPA, 2013d)

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 Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The “releases” do not necessarily equate to chemical exposure by humans or necessarily constitute 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 2013, Georgia had 681 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Georgia released 70.5 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases primarily from the electric utility and chemical industries. This accounted for 1.72 percent of nationwide releases, ranking Georgia 18 of 56 states and territories, based on total releases per square mile. (USEPA, 2016i)

Another USEPA program is the NPDES, which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of October 2015, Georgia had 203 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015k).

The National Institutes of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (NIH, 2015). Figure 6.1.15-2 provides an overview of potentially hazardous sites in Georgia.



**Figure 6.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Georgia (2013)**

## 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 waterbodies. 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 December 2016, there are 32 USEPA-regulated telecommunications sites in Georgia (USEPA, 2015l). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

### Spotlight on Georgia Superfund Sites: Armstrong World Industries

Armstrong World Industries is a 130-acre site located in an industrial area of Macon, GA. Between 1969 and 1970, Armstrong World Industries coated acoustic ceiling tiles with a PCB-containing formulation. The formulation was later recalled, but an adjacent landfill may have been used to dispose of the PCB-contaminated tiles, as well as other industrial waste and equipment since the 1960s. The adjoining Macon Naval Ordnance Plant also disposed of solid wastes, ordnance, and debris in the landfill. The site was placed on the NPL in 2011, and is currently under investigation by the USEPA and GAEPD. (USEPA, 2015m)

The site drains into Rocky Creek (Figure 6.1.15-3), a local recreation and fishing area, located south of the site. High levels of PCBs, metals, and other contaminants were identified in landfill soils, surface water, and sediments. The GADPH determined that people who ate fish caught in Rocky Creek could be exposed to harmful levels of PCBs, and present an increased risk of cancer. GADPH also determined that exposure to contaminated soil at the site landfills is unlikely, and not expected be harmful to public health due to landfill access restrictions. (GADPH, 2012)



Source: (GADPH, 2012)

**Figure 6.1.15-3: Photos of Rocky Creek**

According to BLS data, Georgia had six occupational fatalities in 2004 and three in 2009 within the line installers and repairers occupations from exposure to “harmful substances or environments,” although these were not specific to telecommunications (BLS, 2015d). 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, 2015e). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014b).

### **Public Health and Safety**

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general 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 GADOH is administers the Georgia Occupational Health and Safety Surveillance Program, which collects injury, illness, and hazard information and raises public awareness of workplace rights (GADPH, 2015b). At the federal level, the Centers for Disease Control and Prevention (CDC), National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography.

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

Another health and safety hazard in Georgia includes surface and subterranean mines, which are generally located in the northwest corner of the state. In 2015, the Georgia mining industry ranked 17<sup>th</sup> for non-fuel minerals (primarily clays, crushed stone, cement, sand and gravel), generating a value of \$1.70B (USGS, 2016a). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015).

Figure 6.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Georgia, 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 December 2015, Georgia had 22

Priority 1 and 2 AMLs, with 1 unfunded problem area (USDOJ, Office of Surface Mining Reclamation and Enforcement, 2015a).

In addition to hazardous waste contamination, another health and safety hazard includes surface and subterranean mines. Health and safety hazards known to be present at active mines and AML include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015). Gradual settling or sudden sinking of the Earth's surface, also known as subsidence, presents additional risks and is further discussed in Section 6.1.3, Geology. As of May 2015, there were no high priority AMLs (sites posing health and safety hazards) in Georgia (USDOJ, Office of Surface Mining Reclamation and Enforcement, 2015b).

### Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or mine fires, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.



Source: (USDOJ, Office of Surface Mining Reclamation and Enforcement, 2015c)

**Figure 6.1.15-4: High Priority Abandoned Mine Lands in Georgia (2015)**

### 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 (USDOJ, Office of Surface Mining Reclamation and Enforcement, 2015d).

#### **6.1.15.6. Environmental Setting: Natural and Manmade Disaster Sites**

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the public. Telecommunications, including public safety communications, can be 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.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003).

#### **Spotlight on Georgia Natural Disaster Sites: Winter Storm 2014**

In late January 2014, an arctic air mass moved across central United States, bringing freezing temperatures that mixed with moist air from the Gulf of Mexico, causing rain, sleet, and snow to fall in northern Georgia. The storm struck midday on Tuesday, January 28, with rapid snow accumulation of two to four inches on roadways, as people attempted to commute home. The volume of traffic caused ice buildup on roads, gridlocking traffic in the metro Atlanta area, and stranding motorists in their vehicles for up to 20 hours (Figure 6.1.15-5). Many motorists abandoned their vehicles and attempted to walk in treacherous conditions. Reportedly, there were over 1,500 storm-related accidents and over 180 injuries, as well as multiple power outages throughout the region. (NOAA, 2014e)



Source: (NOAA, 2014f)

**Figure 6.1.15-5: Atlanta Traffic During the Winter Storm**

Physical hazards may also be present at disaster sites, such as downed utility lines, debris blockage or road washout conditions, which increases exposure risks to telecommunication workers. Climbing and working from tower structures damaged by wind increases the risk of slips, trips, or falls. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris.

### **Telecommunication Worker Occupational Health and Safety**

Telecommunication workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, the GADOL 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 362 NRC-reported incidents for Georgia in 2014 with known causes, only 12 were attributed to natural disaster (e.g., earthquake, flood, hurricane, tornado, or other natural phenomenon), while the majority (350) were attributed to manmade disasters (e.g., derailment, dumping, equipment failure, operator error, over pressuring, suicide, transport accident, or trespasser) (USCG, 2015). For example, during a severe winter storm in mid-February 2014, interstates and highways throughout north Georgia were covered by snow and ice. During this event, a tanker truck overturned on an icy roadway and released ethanol onto the road surface (USCG, 2014). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural and manmade disasters.

### **Public Health and Safety**

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the 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. In 2014, Georgia reported 2 weather-related fatalities (both due to lightning strikes) and 35 injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015c)

## 6.2. ENVIRONMENTAL CONSEQUENCES

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews.

At the programmatic level, the categories of impacts have been defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the Proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance. Indirect impacts are those impacts related to the Proposed Action but result from an intermediate step or process, such as changes in surface water quality because of soil erosion.

For each resource, the potential impact is assessed in terms of context of the action and the intensity of the potential impact, per CEQ regulations (40 CFR §1508.27). *Context* refers to the timing, duration, and where the impact could potentially occur (i.e., local vs. national; pristine vs. disturbed; common species vs. protected species). In terms of duration of potential impact, context is described as short or long term. *Intensity* refers to the magnitude or severity of the effect as either beneficial or adverse. Resource-specific significance rating criteria are provided at the beginning of each resource area section.

### 6.2.1. Infrastructure

#### 6.2.1.1. Introduction

This section describes potential impacts to infrastructure in Georgia associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, Best Management Practices (BMPs) and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### 6.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 6.2.1-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and

duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

### **6.2.1.3. Description of Environmental Concerns**

#### **Transportation System Capacity and Safety**

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., Georgia Department of Transportation, airport authorities, railway companies, and harbor masters) to ensure proper coordination during deployment.

Based on the impact significance criteria presented in Table 6.2.1-1, such impacts would be *less than significant* at the programmatic level due to the temporary nature of the deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

#### **Capacity of Local Health, Public Safety, and Emergency Response Services**

The capacity of local health, public safety, and emergency response services, at the programmatic level, would experience *less than significant* impacts during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 6.2.1-1, potential negative impacts would be *less than significant* at the programmatic level. Substantial beneficial impacts are likely to result from implementation.

**Table 6.2.1-1: Impact Significance Rating Criteria for Infrastructure at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is <i>potentially significant</i> , but with mitigation <i>is less than significant</i> .	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	<i>No effect</i> on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is <i>potentially significant</i> , but with mitigation <i>is less than significant</i> .	Minor delays to access to care and emergency services that do not impact health outcomes.	<i>No impacts</i> on access to care or emergency services.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system (“brownouts”). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

### **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 6.2.1-1, any potential impacts, at the programmatic level, would be *less than significant* during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience such beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus such infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be *less than significant* at the programmatic level given the short-term nature of deployment activities.

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

Commercial assets would be using a different spectrum for communications; as such, commercial telecommunication systems, communications, or level of service would experience *no impacts* at the programmatic level. 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.<sup>153</sup> Anticipated impacts would be *less than significant* at the programmatic level due to the limited extent and temporary nature of deployment.

### **Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities**

The activities proposed by FirstNet would have *less than significant* impacts at the programmatic level on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or

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<sup>153</sup> 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.

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.

#### **6.2.1.4. Potential Impacts of the Preferred Alternative**

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

### **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, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to infrastructure under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to infrastructure resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes 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* to infrastructure resources at the programmatic level because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
  - **New Build – Submarine Fiber Optic Plant:** At the programmatic level, the installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. Impacts to infrastructure resources associated with the construction of landings and/or facilities on shore or the banks of water bodies that accept the submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.

- 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 infrastructure at the programmatic level. The section below addresses potential impacts to infrastructure if construction of new boxes, huts, or other equipment is required near or adjacent to local infrastructure assets.
- 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 Nationwide Public Safety Broadband Network (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 at the programmatic level, it is anticipated that this activity would have *no impact* on infrastructure resources.

*Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs),<sup>154</sup> huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase; however, it is anticipated that this tie-in would cause *less than significant* impacts at the programmatic level as the activity would be temporary and minor.

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<sup>154</sup> Points of Presence are connections or access points between two different networks, or different components of one network.

- New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new, or replacement of existing telecommunications poles.
- Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
- New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in limited nearshore or inland bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact, other than harbor operations. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable, depending on the exact site location and proximity to existing infrastructure.
- Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to infrastructure. However, if installation of transmission equipment such as small boxes or huts, or access roads required ground disturbance, then the activities 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 tower site such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site-specific plans.
  - Deployable Technologies: Deployable technologies such as Cells on Wheels (COWs), Cells on Light Trucks (COLTs), and Systems on Wheels (SOWs) are composed of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is

expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. 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 utilized but launched from existing paved surfaces, it is anticipated that there would be *no impacts* to infrastructure resources at the programmatic level because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electric grid. These impacts are expected to be *less than significant* at the programmatic level as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), would be regionally based around the on-going phase of deployment, and minor. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

### **Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated, at the programmatic level, 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 established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur.

These potential impacts would be expected to be minor and temporary as explained above and therefore, *less than significant* at the programmatic level.

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. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.1.5. 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, at the programmatic level, implementation of deployable technologies could result in *less than significant* impacts to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation,

telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated, at the programmatic level, 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 an established access road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, *less than significant* impacts would likely still occur to transportation systems or utility services at the programmatic level due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **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 as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

## **6.2.2. Soils**

### **6.2.2.1. Introduction**

This section describes potential impacts to soil resources in Georgia associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.2.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 6.2.2-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

### **6.2.2.3. Description of Environmental Concerns**

#### **Soil Erosion**

Soil erosion is an environmental concern for nearly every construction activity that involves ground disturbance. Construction erosion typically only occurs in a small area of land with the actual removal of vegetative cover from construction equipment or by wind and water erosion. Of concern in Georgia 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 Georgia that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Udepts and Udufts (see Section 6.1.2.4, Soil Suborders and Figure 6.1.2-2).

Based on the impact significance criteria presented in Table 6.2.2-1, building of some of FirstNet's network deployment sites could cause *potentially significant* erosion at locations with highly erodible soil and steep grades. For the majority of projects, impacts to soils would be expected to be *less than significant* at the programmatic level given the short-term and temporary duration of the construction activities.

To the extent practicable, FirstNet would likely attempt to minimize ground disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures, where practicable and feasible, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 16).

**Table 6.2.2-1: Impact Significance Rating Criteria for Soils at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

## 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 6.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, *less than significant* impacts from the minimal topsoil mixing is expected at the programmatic level. Additionally, implementation of BMPs and mitigation measures (Chapter 16), could further reduce potential impacts.

## Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 6.1.2.4, Soil Suborders). The most compaction susceptible soils in Georgia are Aqualfs, Aquepts, Aquods, Aquolls, Aquults, Hemists, and Sapristis, which are hydric soils with poor drainage conditions. These soils are found in approximately 21 percent of Georgia<sup>155</sup> (see Figure 6.1.2-2). 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 6.2.2-1, at the programmatic level, 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 and the relatively small-scale (less than one acre) of most FirstNet project sites. Potential impacts could be further reduced with the implementation of BMPs and mitigation measures.

### 6.2.2.4. Potential Impacts of the Preferred Alternative

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

## Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

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<sup>155</sup> 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 at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to soil resources 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 would have *no impact* on soil resources at the programmatic level because it would not produce perceptible changes to soil resources.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, with *no impacts* to soil resources at the programmatic level. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures. Impacts to soil resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below, and depend on the proximity of such infrastructure to the landing site.
  - **New Build – Submarine Fiber Optic Plant:** The installation of cables in or near bodies of water would have *no impacts* on soil resources at the programmatic level because there would be no ground disturbance associated with this activity (see Section 6.2.4, Water Resources, for a discussion of potential impacts to water resources). Impacts to soil resources associated with the construction of landings or facilities on shore to accept submarine cable are addressed below.
  - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils at the programmatic level. The section below addresses potential impacts to soils if construction of new boxes, huts, or other equipment is required.
  - **Collocation on Existing Aerial Fiber Optic Plant:** Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on soils at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to soils associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
- **Wireless Projects**
  - **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation is the mounting or installing of new equipment on existing structures (such as antennas on an existing tower). This activity would have *no impact* on soil resources at the programmatic level because there would be no ground disturbance. Potential impacts to soil resources from structural hardening, addition of power units, or security measures are addressed below.

- Deployable Technologies: Where technologies such as Cell on Wheels (COW), Cell on Light Trucks (COLT), or System on Wheels (SOW) are deployed on existing paved surfaces or dirt or gravel areas, there would be *no impacts* to soil resources at the programmatic level because there would be no ground disturbance. Potential impacts associated with paving of previously unpaved surfaces or other ground disturbing activities are addressed below.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, would have *no impact* on soil resources at the programmatic level 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 soil resources, it is anticipated that this activity would have *no impact* on soil resources.

#### *Activities with the Potential to Have Impacts at the Programmatic Level*

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources at the programmatic level include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: As stated above, collocation with no ground disturbance would result in *no impacts* to soil resources at the programmatic level. However, topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and

- topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, lighting up of dark fiber in existing conduits or cables would have *no impact* on soil resources at the programmatic level, however, if installation of new huts or equipment were necessary, the activity could result in soil erosion and topsoil mixing during grading or excavation activities. This activity could also require the short-term use of heavy equipment for grading or other purposes, which could result in soil compaction and rutting.
  - New Build – Submarine Fiber Optic Plant: As stated above, the installation of cables in or near bodies of water would not impact soil resources at the programmatic level because there would be no soils to impact. However, installation of fiber optic plants in limited nearshore and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shores or the banks of waterbodies that accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.
  - Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to soils at the programmatic level. However, installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.
  - Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
    - Collocation on Existing Wireless Tower, Structure, or Building: As stated above, collocation that would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, would result in *no impacts* on soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.

- **Deployable Technologies:** As stated above, if deployment occurred on paved surfaces or previously disturbed land, there would be *no impact* on soil resources, however, implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads, and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be *less than significant* at the programmatic level as the activity would likely be short term, localized to the deployment locations, and those locations would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

As described 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, at the programmatic level, there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be *less than significant* at the programmatic level due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.2.5. 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*

Impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale and short-term nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that, at the programmatic level, there would be *no impacts* to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. At the programmatic level, 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 at the programmatic level, as described

above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to soil resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.2, Soils.

## **6.2.3. Geology**

### **6.2.3.1. Introduction**

This section describes potential impacts to Georgia geology resources associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.3.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 6.2.3-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geological resources addressed in this section are presented as a range of possible impacts.

### **6.2.3.3. Description of Environmental Concerns**

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts on the project, such as seismic hazards, and landslides, and those that would have impacts from the project, such as land subsidence and effects on mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geological resources are discussed below.

**Table 6.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Seismic Hazard	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within an earthquake hazard zone or active fault.	No likelihood of a project activity being located in an earthquake hazard zone or active fault.
	Geographic Extent	Hazard zones or active faults are highly prevalent within the state/territory.		Earthquake hazard zones or active faults occur within the state/territory, but may be avoidable.	Earthquake hazard zones or active faults do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Volcanic Activity	Magnitude or Intensity	High likelihood that a project activity could be located near a volcano lava or mud flow area of influence.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located near a volcanic ash area of influence.	No likelihood of a project activity located within a volcano hazard zone.
	Geographic Extent	Volcano lava flow areas of influence are highly prevalent within the state/territory.		Volcano ash areas of influence occur within the state/territory, but may be avoidable.	Volcano hazard zones do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.
	Geographic Extent	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

## Seismic Hazard

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. As discussed in Section 6.1.3, the majority of Georgia is not at risk to significant earthquake events. As shown in Figure 6.1.3-4, northern and eastern regions of Georgia at greatest risk to earthquakes throughout the state. Between 1973 and March 2012, there were nine earthquakes of a magnitude 3.5 (on the Richter scale<sup>156</sup>) or greater originating in Georgia (ETK, 2017), but considerably more originated outside of the state that were felt in the state. Based on the impact significance criteria presented in Table 6.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have *no impact* on seismic activity at the programmatic level; however, seismic impacts to the Proposed Action could be *potentially significant* at the programmatic level if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for minor earthquakes in or near Georgia, some amount of infrastructure could be subject to earthquake hazards. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## Volcanic Activity

Volcanoes were considered but not analyzed for Georgia, as they do not occur in Georgia; therefore, volcanoes do not present a hazard to the state.

## Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 6.1.3, the majority of Georgia is at low to moderate risk of experiencing landslide events. Based on the impact significance criteria presented in Table 6.2.3-1, potential impacts to landslides from deployment or operation of the Proposed Action would *have less than significant* impacts at the programmatic level; 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. The highest potential for landslides in Georgia is greatest in the Piedmont, Blue Ridge, and Valley and Ridge Provinces, particularly in locations where there has been land disturbance (GAGOV, 2014). Landslides in Georgia also may be triggered by earthquakes (USGS, 1997). To the extent practicable, FirstNet would likely avoid deployment in areas that are susceptible to landslide events. However, given that several of Georgia's major

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<sup>156</sup> 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, 2014b)

cities, including Albany and Binghamton, are in areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Land Subsidence**

Equipment that is exposed to land subsidence, such as sinkholes created by karst topography is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, in coastal areas could lead to relative sea level rise<sup>157</sup> and inundation of equipment. All of these activities could result in connectivity loss.

As discussed in Section 6.1.3.8 and shown in Figure 6.1.3-5, portions of Georgia are vulnerable to land subsidence due to karst topography. Based on the impact significance criteria presented in Table 6.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have *less than significant* impacts at the programmatic level; however, subsidence impacts to the Proposed Action could be *potentially significant* to the Proposed Action if FirstNet's deployment locations were within areas at high risk to karst topography. To the extent practicable, FirstNet would likely avoid deployment in known areas of karst topography or in areas that are subject to sea level rise. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures could help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Potential Mineral and Fossil Fuel Resource Impacts**

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. To the extent practicable, FirstNet would likely avoid construction in areas where these resources exist. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Potential Paleontological Resource Impacts**

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 6.2.3-1, impacts to paleontological resources could be *potentially significant* if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 6.1.3.7, fossils are abundant

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<sup>157</sup> 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, 2016e).

throughout parts of Georgia. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Additionally, it is anticipated that potential impacts to specific areas known to contain paleontological resources would be avoided, minimized, or mitigated, and any potential impacts would be limited and localized. Thus, potential impacts would be *less than significant* at the programmatic level. Implementation of BMPs and mitigation measures could further help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **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 6.2.3-1, impacts could be *potentially significant* if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes. Construction activities related to the Proposed Action and Alternatives are likely to be minor and *less than significant* at the programmatic level, as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures could be implemented to help avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.3.4. 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**

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities have the potential to be impacted by geologic hazards, some activities could result in potential impacts to geological resources, and other activities would have *no impacts*. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to geologic 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. 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. The section below addresses potential impacts if entry/exit points are installed in coastal locations that are susceptible to land subsidence.
  - **Collocation on Existing Aerial Fiber Optic Plant:** Collocation of new aerial fiber optic plant on existing utility poles and other structures would have *no impact* on geologic resources at the programmatic level because there would be no ground disturbance for pole/structure installation, and heavy equipment use would be typically limited to bucket trucks operated from existing paved, gravel, or dirt roads. Impacts to geologic resources associated with the construction of new poles to accept aerial fiber or on shore to accept submarine cable are addressed below.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to geologic resources because there would be no ground disturbance at the programmatic level. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would have *no impacts* to/from geologic resources at the programmatic level. Potential impacts associated with ground disturbing activities are discussed below.
  - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to geologic resources at the programmatic level. The section below addresses potential impacts if the boxes/huts are installed in locations that are susceptible to specific geologic hazards (e.g., land subsidence, landslides, or earthquakes).
- **Wireless Projects**
  - **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in *no impacts* to geologic resources at the programmatic level if no ground disturbance were associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact geologic resources if this activity did not require ground disturbance. The section below addresses potential impacts if ground disturbing activities occur in locations that are susceptible to specific geologic hazards.
  - **Deployable Technologies:** Where deployable technologies would be implemented on existing paved surfaces, there would be *no impacts* to/from geologic resources at the

programmatic level because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts associated with site preparation for staging or landing areas is discussed below.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* geologic resources at the programmatic level because those activities would not require ground disturbance. The section below addresses potential impacts if ground disturbance activities occur in locations that are susceptible to specific geologic hazards
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have *no impact* on geologic resources.

#### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: As stated above, if collocation does not require new utility poles or ground disturbance, there would be *no impacts* to geologic resources. However, replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, although lighting up of dark fiber would have *no impacts* to geologic resources at the programmatic level, installation of new associated huts or equipment, if required, could result in ground disturbance during grading or excavation activities. Where equipment is installed in locations that are susceptible to specific geologic hazards, it is possible that equipment could be affected by that hazard.
- Use of Existing Conduit – New Buried Fiber Optic Plant: As stated above, disturbance associated with the installation of fiber optic cable in existing conduit have *no impacts* to geologic resources at the programmatic level. However, if fiber were installed in locations susceptible to landslides, earthquakes, or other geologic hazards, it is possible that the equipment could be affected by that hazard.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water is not expected to impact geologic resources including marine paleontological resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- Installation of Optical Transmission or Centralized Transmission Equipment: As mentioned above, if installation of equipment were to take place in existing facilities, there would be *no impact* to/from geologic resources. However, if installation of transmission equipment would occur in existing boxes or huts 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: As stated above, collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance and, therefore, would have *no impact* on geologic resources. However, if the additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Deployable Technologies: As stated above, where deployable technologies would be implemented on existing paved surfaces, there would be *no impacts* to/from geologic

resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. However, implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: As stated above, the installation of permanent equipment on existing structures, adding equipment to satellites launched for other purposes, or the use of portable devices that use satellite technology would have *no impact* on geologic resources because those activities would not require ground disturbance. Where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet Proposed Actions are likely to be small-scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small-scale. As a result, these potential impacts are expected to be *less than significant* at the programmatic level. For the same reason, impacts to deployment from geologic hazards are likely to be *less than significant* at the programmatic level as well. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to further avoid or minimize potential impacts.

## Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that, at the programmatic level, there would be *no impacts* to geologic resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by geologic hazards, including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level, as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.3.5. Alternatives Impact Assessment**

The following section assesses potential impacts to geologic 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 geologic resources 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. At the programmatic level, these impacts are expected to be *less than significant* due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that, at the programmatic level, there would be *no impacts* to

geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative because there would be no ground disturbance.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as the deployment would be temporary and likely would attempt to avoid locations that was subject to increased seismic activity, landslides, and land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to geologic resources (or from geologic hazards) as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.3, Geology.

## **6.2.4. Water Resources**

### **6.2.4.1. Introduction**

This section describes potential impacts to water resources in Georgia associated with deployment and operation of the Proposed Action. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to water resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

### **6.2.4.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 6.2.4-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

**Table 6.2.4-1: Impact Significance Rating Criteria for Water Resources at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity; violation of various regulations including: CWA, SDWA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Floodplain degradation <sup>a</sup>	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology; high likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> at the programmatic level.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

NA = Not Applicable

<sup>a</sup> Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See <http://www.archives.gov/federal-register/codification/executive-order/11988.html> and <https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and>).

### **6.2.4.3. 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 603(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.

All of the surface waters in the state have been degraded to some extent. Most of Georgia's rivers and streams are impaired (59 percent), although only 36 percent of Georgia's lakes, reservoirs, and ponds are impaired (see Table 6.1.4-2 and Figure 6.1.4-3). Only 6 percent of Georgia's estuaries and bays are impaired, and 9 percent of the state's coastal shoreline. Sources include nonpoint<sup>158</sup> sources, urban-related runoff/stormwater, industrial/commercial site stormwater discharge, and municipal point<sup>159</sup> source discharge. Groundwater quality within the state is generally good, although the Southeastern Coastal Plain aquifer is sometimes impacted from saltwater intrusion. (USEPA, 2015n)

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal onsite 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 Pollutant Discharge Elimination System (SPDES) or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs could help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

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<sup>158</sup> Nonpoint source pollution: A source of pollution that does not have an identifiable, specific physical location or a defined discharge point. Non-point source pollution includes nutrients that run off croplands, lawns, parking lots, streets and other land uses. It also includes nutrients that enter waterways via air pollution groundwater, or septic systems. (USEPA, 2015c)

<sup>159</sup> A source of pollution that can be attributed to a specific physical location – an identifiable, end-of-pipe “point.” (USEPA, 2015c)

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, at the programmatic level, based on the impact significance criteria presented in Table 6.2.4-1, water quality impacts would likely be *less than significant* and could be further reduced particularly if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching<sup>160</sup> 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 Georgia dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Georgia aquifers, there is 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 quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 6.2.4-1, there would likely be *less than significant* impacts at the programmatic level on groundwater quality within most of the state. In areas where groundwater is close to the surface site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Furthermore, BMPs and mitigation measures could be implemented to further reduce potential impacts.

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<sup>160</sup> 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).

## Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 6.2.4-1, floodplain degradation impacts would be *less than significant* at the programmatic level since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would use minimal fill, would not substantially increase impervious surfaces, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any effects would be temporary, lasting no more than one season or water year,<sup>161</sup> or occur only during an emergency.

Examples of activities that would have *less than significant* impacts at the programmatic level include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations;
- Land uses that include pervious surfaces such as gravel parking lots;
- Land uses that do not change the flow of water or drainage patterns; and
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

## Drainage Pattern Alteration

Flooding and erosion from land disturbance could change drainage patterns. Storm water 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 6.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the

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<sup>161</sup> 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, 2016f).

programmatic level. Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff;
- Where stormwater is contained onsite 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; and
- 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* at the programmatic level. BMPs and mitigation measures could be implemented to further reduce potential 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 6.2.4-1. At the programmatic level, 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 at the programmatic level include:

- Construction of any structure in a 100-year or 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations;
- Land uses that are maintaining or increasing pervious surfaces;
- Land uses that do not change the flow of water or drainage patterns offsite or into surface waterbodies that have not received that volume of stormwater previously; and
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts at the programmatic level would be *less than significant* to flow alteration. BMPs, mitigation measures, and avoidance could be implemented to further reduce impacts.

## Changes in Groundwater or Aquifer Characteristics

As described in Section 6.1.4.7, groundwater is the main source of drinking water statewide, and especially in more rural areas. 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 Georgia'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 be unlikely to cause *significant* impacts to water quality due to the expected small volume of these materials. Activities that may cause changes in groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction;
- Any liquid waste, including but not limited to wastewater, generation; and
- Storage of petroleum or chemical products.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities should be *less than significant* at the programmatic level since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should be considered to avoid areas that would extract groundwater from potable groundwater sources in the area. According to Table 6.2.4-1, *potentially significant* impacts to groundwater or aquifer characteristics would only occur if actions resulted in substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime on a watershed or within multiple watersheds that is ongoing and permanent. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.4.4. Potential Impacts of the Preferred Alternative at the Programmatic Level**

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

#### **Potential 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 could result in potential impacts to water resources and others would not. In addition, and as explained in this section, the various types of Preferred Alternative Infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level 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 (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to water resources at the programmatic level under the conditions described below:

- **Wired Projects**
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to water resources at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to water resources at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance, construction in floodplains, or use of motorized equipment near streams.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have *no impact* on water resources at the programmatic level.

#### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential construction/deployment-related impacts to water resources as a result of implementation of the Preferred Alternative would encompass a range of potential impacts that could occur as a result of ground disturbance activities, including in-stream construction work, resulting primarily in sediments entering streams, but also potentially to near-shore or inland waters, as well as the potential for other impacts to water quality and floodplains. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- **Wired Projects**
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or

hand-holes to access fiber could result in potential impacts to water resources. Ground disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in stream sedimentation, construction of impervious surfaces and structures in floodplains, stream channel alteration, and accidental spills of fuels or lubricants to waterbodies.

- New Build – Buried Fiber Optic Plant: Projects could present a higher risk to water resources because of their relatively high degree of soil disturbance compared to the other types of projects. Implementing BMPs and mitigation measures could reduce impact intensity.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could potentially impact water quality due to disruption of sediments on the floor of the waterbody. Impacts to water resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable. Sediments entering limited near-shore or inland waterbodies could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Construction of facilities in floodplains could potentially impact floodplain functionality and drainage patterns.
- New Build – Aerial Fiber Optic Plant: Soil exposure from installation of new poles or construction of new roads, POPs, huts, or other facilities near waterbodies could result in ground disturbance, potentially resulting in sediment deposition and increased turbidity in nearby waterbodies. The use of heavy equipment during the installation of new poles and cables could result in potential soil disturbance and the resulting potential sedimentation impacts to streams, disturbance of riparian vegetation, leaching of PCPs, and accidental spills of fuels or lubricants to waterbodies.
- Collocation on Existing Aerial Fiber Optic Plant: Ground disturbance during the replacement of poles and structural hardening could result in potential soil erosion and sedimentation impacts to streams, particularly where this work would be done in proximity to waterbodies. Collocation on Existing Aerial Fiber Optic Plant projects could present a lower risk to water resources because of their relatively low degree of soil disturbance compared to the other types of projects.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to water resources at the programmatic level.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources because there would be no ground disturbance or in-water construction associated with this activity. The potential addition of power units, structural hardening, and physical security measures would not impact water resources if this activity would not require ground disturbance or in-water construction. However, if the on-site delivery of additional power units, structural hardening, and physical security measures required travel through streams or ground disturbance, such as grading or excavation activities near streams, potential impacts to water resources could occur including stream sedimentation and physical disturbance associated with heavy equipment use.
- Deployable Technologies
  - Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in 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 at the programmatic level because there would be no ground disturbance.
  - Deployment of drones, balloons, blimps, or piloted aircraft could have indirect impacts on water quality if fuels spill or other chemicals seep into ground or surface waters. In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with

deployment of this infrastructure could include water quality impacts, but are expected to be *less than significant* at the programmatic level due to the small scale of individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be *less than significant* at the programmatic level due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Potential Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to water resources at the programmatic level associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all refueling and vehicle maintenance BMPs and mitigation measures are followed. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### ***6.2.4.5. Alternatives Impact Assessment***

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

### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the

Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this Alternative could be as described below.

#### *Potential Deployment Impacts*

As explained above, at the programmatic level, 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; however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuel leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have *less than significant* impact at the programmatic level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Potential Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that, at the programmatic level, there would be *no 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; however, due to the limited and temporary nature of the deployable activities, it is anticipated that these

potential impacts would be *less than significant* at the programmatic level. Site maintenance, including mowing or herbicides, may result in *less than significant* effects to water quality, due to the small scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to water resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.4, Water Resources.

## **6.2.5. Wetlands**

### **6.2.5.1. Introduction**

This section describes potential impacts to wetlands in Georgia associated with deployment and operation of the Proposed Action and alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to wetland resources. Implementation of BMPs, as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

### **6.2.5.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 6.2.5-1. As described in Section 6.2, Environmental Consequences, the categories of impacts at the programmatic level are defined as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

**Table 6.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude <sup>a</sup> 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 604 of the CWA.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent loss, degradation, or conversion to non-wetland.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to wetlands.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Effects: <sup>b</sup> Change in Function(s) <sup>c</sup> or Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent change in function or type that is not restored within two growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

NA = Not Applicable

<sup>a</sup> “Magnitude” is defined based on the type of wetland impacted, using USACE wetland categories. Category 1 are the highest quality, highest functioning wetlands.

<sup>b</sup> 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.

<sup>c</sup> 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.

### 6.2.5.3. *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, vibrations, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

There are more than 5 million acres of palustrine, riverine, lacustrine, and estuarine/marine wetlands throughout Georgia (USFWS, 2017a). These wetlands begin at Georgia's coastline and extend through at least half the state prolifically (see Figure 6.1.5-1).

Based on the impact significance criteria presented in Table 6.2.5-1, the deployment activities would most likely have *less than significant* direct impacts on wetlands at the programmatic level. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and locally required regulations.

There are several important wetland sites in Georgia, including the Okefenokee Swamp, more than 20 WMA properties, several wetland National Natural Landmarks, and other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups, as described in Section 6.1.5.4, Important Wetland Sites in Georgia. If any of the proposed deployment activities were to occur in these important wetland sites, *potentially significant* impacts could occur. Important wetland sites occur throughout the state, and are not always include on state maps; therefore, site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work to avoid *potentially significant* impacts to wetlands. Potential wetlands impacts could

be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### Potential Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause *potentially significant* impacts. In addition, introduction and establishment of invasive species to wetlands within a watershed or multiple watersheds could be *potentially significant*. Based on the impact significance criteria presented in Table 6.2.5-1, other direct effects to high- and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Georgia 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 parameter.
- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

### **Indirect Effects:<sup>162</sup> Change in Function(s)<sup>163</sup> or Change in Wetland Type**

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to high- and low-quality wetlands would be *less than significant* at the programmatic level given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and locally required wetlands regulations. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of functions related to wetlands in Georgia 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.

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<sup>162</sup> 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.

<sup>163</sup> Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value:* Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge:* Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 6.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered *less than significant* at the programmatic level. Since the majority of wetlands in Georgia are not considered high quality, deployment activities could have *less than significant* indirect impacts at the programmatic level on wetlands in the state. In areas of the state with important wetland sites, there could be *potentially significant* impacts at the project level that may require site-specific analysis depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If avoidance were not possible, potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.5.4. Potential Impacts of the Preferred Alternative at the Programmatic Level**

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

#### **Potential Deployment Impacts**

As described in Section 2.1.2, 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 Preferred Alternative Infrastructure could result in a range of *no impacts* to *potentially significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions.

### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to wetlands at the programmatic level under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to wetlands at the programmatic level since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to wetlands at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
  - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would not impact wetlands, it is anticipated that this activity would have *no impact* on wetlands at the programmatic level.

### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- **Wired Projects**
  - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Deployable Technologies
  - Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The

activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, blimps, or 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. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be *less than significant* at the programmatic level due to the small amount of land disturbance (generally less than one acre) and the short timeframe of deployment activities. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to further avoid or minimize potential impacts.

### **Potential Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned potential deployment impacts. Depending on the proximity to wetlands, it is anticipated that there could be ongoing other potential direct impacts to wetlands if heavy equipment is used for routine operations or maintenance or if application of herbicides occurs to control vegetation along ROWs and near structures. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are not expected to be *less than significant* at the programmatic level due to the limited nature of deployment activities. It is also anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all federal, state, and local requirements associated with refueling and vehicle maintenance are followed. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to further avoid or minimize potential impacts.

#### **6.2.5.5. Alternatives Impact Assessment**

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

## Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this Alternative could be as described below.

### *Potential Deployment Impacts*

As explained above, at the programmatic level, 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 indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to further avoid or minimize potential impacts.

### *Potential Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be *less than significant* impacts at the programmatic level to wetlands associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in *less than significant* impacts to wetlands at the programmatic level due to the limited nature of site maintenance activities, including mowing and application of herbicides. 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. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wetlands from the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.5, Wetlands.

## **6.2.6. Biological Resources**

### **6.2.6.1. Introduction**

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Georgia associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.6.2. 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 6.2.6-1. As described in Section 6.2, Environmental Consequences, the categories of impacts at the programmatic level are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 6.2.6.3, 6.2.6.4, and 6.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 6.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species in Georgia.

**Table 6.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury/mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including: Marine Mammal Protection Act (MMPA), Magnuson Stevens Fishery Conservation And Management Act (MSFCMA), MBTA, and Bald and Golden Eagle Protection Act (BGEPA).	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Georgia for at least one species. Anthropogenic <sup>a</sup> 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: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Georgia 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: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Georgia 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: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Georgia 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: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Georgia for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is <i>potentially significant</i> , but with BMPs and mitigation measures is <i>less than significant</i> .	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Georgia.		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

NA = Not Applicable.

<sup>a</sup> 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, 2016zz)

### **6.2.6.3. Terrestrial Vegetation**

Impacts to terrestrial vegetation occurring in Georgia's environment 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 6.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, FirstNet deployment events are expected to be relatively small in scale and therefore would have *less than significant* impacts at the programmatic level. The implementation of BMPs and mitigation measures and avoidance measures could help to minimize or altogether avoid potential impacts to plant population survival. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

##### *Vegetation and Habitat Loss, Alteration, or Fragmentation*

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. A large portion of southern Georgia has experienced extensive land use changes from agriculture, while areas surrounding major cities have experienced extensive land use change from urbanization. However, a large portion of the state remains relatively unfragmented, particularly privately owned forests in northern, central, and southeastern Georgia. (GFC, 2015)

Construction of new infrastructure and long-term facility maintenance could result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. In general, these impacts are expected to be *less than significant* at the programmatic level due to the short-term, localized nature of the deployment activities. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be recommended and consultation with appropriate resources agencies, if required, could be undertaken to minimize or avoid potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for *adverse effects* to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as the Wildlife portion of this Biological Resources Section, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

#### *Indirect Injury/Mortality*

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment. Overall, these impacts are expected to be *less than significant* at the programmatic level due to the short-term and small-scale nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Effects to Migration or Migratory Patterns*

*No effects* to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small scale of deployment activities.

#### *Reproductive Effects*

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action, given the small scale of deployment activities.

#### *Invasive Species Effects*

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity. The state of Georgia does not maintain a list of regulated noxious weeds. The Georgia Invasive Species Task Force (Task Force) includes the Georgia Department of Agriculture, Georgia Forestry Commission, GADNR, and the University of Georgia (UGA).

As described in Section 6.1.6.4, when non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. The potential to introduce invasive plants within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Overall, at the

programmatic level, these impacts are expected to be *less than significant* due to the expected small scale and localized nature of likely FirstNet activities. BMPs could help to minimize or avoid the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to vegetation as a result of the introduction of invasive species. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Potential Impacts of the Preferred Alternative**

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

#### *Deployment Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range impacts at the programmatic level, 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,<sup>164</sup> and the nature as well as the extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to terrestrial vegetation under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

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<sup>164</sup> Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds. (USEPA, 2015d)

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to terrestrial vegetation at the programmatic level because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have *no impact* on terrestrial vegetation at the programmatic level.

#### Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. BMPs and mitigation measures could help 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. BMPs and mitigation measures could help to 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 or 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 shores or the banks of waterbodies that 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. BMPs and mitigation measures could help to 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: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale,

could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these impacts are expected to be *less than significant* at the programmatic level due to the small scale and limited geographic scope of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that, at the programmatic level, 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 because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in *less than significant* impacts at the programmatic level due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation; however, impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Alternatives Impact Assessment**

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

#### *Deployable Technologies Alternative*

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies

implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

### Deployment Impacts

As described above, at the programmatic level, 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. Nonetheless, impacts are expected to remain *less than significant* at the programmatic level due to the relatively small scale of FirstNet activities at individual locations. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain *less than significant* at the programmatic level. As with the Preferred Alternative, at the programmatic level, it is anticipated that there would be *less than significant* impacts to terrestrial vegetation associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *No Action Alternative*

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to terrestrial vegetation as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.6.3, Terrestrial Vegetation.

#### **6.2.6.4. Wildlife**

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and invertebrates occurring in Georgia and Georgia's near offshore environment (i.e., less than two miles from the edge of the coast) are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## 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 6.2.6-1, *less than significant* impacts would be anticipated at the programmatic level given that the majority of the proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be minimal, yet measurable, for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. Therefore, impacts are generally expected to be *less than significant* at the programmatic level, as discussed further below (except for birds, which would be *less than significant with BMPs and mitigation measures incorporated*). Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

### Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Georgia. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, foraging, and migration (FHWA, 2009). 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-scale and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats and other species.

### Marine Mammals

All of the marine mammal species (including whales) known to occur offshore of Georgia are also protected under the ESA. Environmental consequences pertaining to these species are discussed in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

## Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. 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 (FAA, 2012b) (Gehring, Kerlinger, & Manville., 2011).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for resting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide with essential habitat that supports various life stages (Hill, et al., 1997).

Direct mortality and injury to birds of Georgia are not likely to be widespread or affect populations of species as a whole due to the small size of the likely FirstNet actions; however, DOI comments dated October 11, 2016<sup>165</sup> state that communication towers are “currently estimated to kill between four and five million birds per year” (Regulations.gov, 2016). Although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights (FAA, 2016c) (FAA, 2016d) (FCC, 2017). Additionally, on Jan. 6, 2017, the FCC issued a notice titled Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs (FCC, 2017). See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If siting considerations, BMPs, and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if

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<sup>165</sup> See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

required, could help to avoid or minimize any potential impacts (including possible “take”). Environmental consequences pertaining to federally listed species will be discussed in Section 6.2.6.6, Threatened and Endangered Species.

### Reptiles and Amphibians

The majority of Georgia’s amphibian and reptile species are widely distributed throughout the state, however, some species have more limited ranges (NGE, 2015b). Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these effects are expected to be temporary and isolated, affecting only individual animals.

Five species of marine turtles – all listed as threatened or endangered under the ESA – occur in Georgia’s offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 6.2.6.6 , Threatened and Endangered Species and Species of Conservation Concern.

### Invertebrates

Ground disturbance or land clearing activities as well as use of heavy equipment could result in direct injury or mortality to invertebrates. However, deployment activities are expected to be temporary and isolated, thereby limiting the potential for direct mortality and likely affecting only a small number of invertebrates. The invertebrate populations of Georgia are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

### *Vegetation and Habitat Loss, Alteration, or Fragmentation*

As described in Section 6.2.6.3, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause exclusion effects only in very special circumstances, as in most cases an animal could fly, swim, or walk to a nearby area that would provide refuge.

In general, potential effects of vegetation and habitat loss, alteration, or fragmentation are expected to be *less than significant* at the programmatic level because of the small-scale nature and limited geographic scope of expected deployment activities. Additionally, FirstNet would attempt to avoid these areas. These potential impacts are described for Tennessee’s wildlife species below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts

### Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Georgia 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 BMPs and mitigation measures (see Chapter 16).

### Marine Mammals

All of the marine mammal species (including whales) known to occur offshore of Georgia are also protected under the ESA. Loss of habitat or exclusions from these areas for marine mammals could be avoided or minimized by implementing BMPs and mitigation measures (see Chapter 16). Environmental consequences pertaining to these species are discussed in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

### Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and GADNR provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitats.

Noise and vibration disturbance and other 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<sup>166</sup> 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 stopovers (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.

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<sup>166</sup> 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.

## Reptiles and Amphibians

Important habitats for Georgia's amphibians and reptiles typically consist of wetlands and, in some cases as with the timber rattlesnake, the surrounding upland forest. Impacts are expected to be *less than significant* at the programmatic level. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 16) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 6.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Georgia's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.<sup>167</sup>

## Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 6.2.6.6, Threatened and Endangered Species and Species of Concern.

### *Indirect Injury/Mortality*

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain *less than significant at the programmatic level* (except for birds and bats due to potential impacts associated with RF emissions) due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, vibrations, light, or other human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in *less than significant* impacts at the programmatic level (except for bats, see below).

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<sup>167</sup> See Section 6.2.5, Wetlands, for a discussion of BMPs for wetlands.

There are no published studies that document physiological or other *adverse effects* to bats from radio frequency (RF) exposure. However, because bats are similar ecologically and physiologically to birds, they have the potential to be affected by RF exposure in similar ways to birds (see the birds subsection below). One study demonstrated that foraging bats avoided areas exposed to varying levels of electromagnetic radiation compared with control sites, and attributed this behavior to the increased risk of overheating and echolocation interference caused by electromagnetic field exposure (Nicholls & Racey, 2009). As stated below, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

### Marine Mammals

Repeated disturbance (e.g., from vessel traffic) could cause stress to individuals resulting in lower fitness and productivity. All of the marine mammal species (including whales) known to occur offshore of Georgia are also protected under the ESA. Environmental consequences pertaining to these species are discussed more in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

### 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 and repeated disturbances would not occur. Depending on the Proposed Action type and location, individual species may be disturbed resulting in *less than significant* impacts at the programmatic level.

Research indicates that RF exposure may adversely affect birds. A comment letter on the Draft Programmatic Environmental Impact Statement for this region, presented by Dr. Albert Manville, former USFWS agency lead on avian-structural impacts, summarizes the state of scientific knowledge of the potential effects of RF exposure on wildlife, particularly migratory birds; the comment letter is presented in its entirety in Appendix G. RF exposure may result in adverse impacts on wildlife, although a distinct causal relationship between RF exposure and responses in wild animal populations has not been established. Further, important scientific questions regarding the mechanisms of impact, the exposure levels that trigger *adverse effects*,

and the importance of confounding factors in the manifestation of effects, among other questions, remain unanswered (Manville, 2016b) (Appendix G).

Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian and mammalian subjects, including embryonic mortality in bird eggs, genetic abnormalities, cellular defects, tumor growth, and reproductive and other behavioral changes in adult birds and rodents (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, White, Guo, & Litovitz, 2002) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Balmori, 2005) (Balmori, 2009) (Balmori & Hallberg, 2007) (Manville, 2016b) (Appendix G). Balmori (2005) documented effects as far as 1,000 feet from an RF source consisting of multiple cellular phone towers. Another study of wild birds conducted by Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise,<sup>168</sup> which can disrupt migration or send birds off course, potentially resulting in reduced survivorship.

Experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on birds and other wildlife and the implications of those effects on wildlife populations over the long term (Manville, 2015) (Manville, 2016b) (Appendix G). Such studies should be conducted over multiple generations and include controls to more clearly establish causal relationships, identify potential chronic effects, and determine threshold exposure levels. FirstNet recognizes that RF exposure may adversely impact wildlife, particularly birds that nest, roost, forage, or otherwise spend considerable time in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

### Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur. Depending on the project type and location,

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<sup>168</sup> Urban electromagnetic noise is a term used to describe an area with a concentration of cell phone towers and users, which by sheer volume and level of use, creates a zone of electromagnetic noise.

individual species may be disturbed resulting in *less than significant* impacts at the programmatic level.

### Invertebrates

Invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be *less than significant* at the programmatic level.

### *Effects to Migration or Migratory Patterns*

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, at the programmatic level, potential impacts are anticipated to be *less than significant* due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Additionally, FirstNet would attempt to avoid areas of known migratory pathways. Potential effects to migration patterns of Georgia's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and invertebrates are described below. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts

### 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.<sup>169</sup>

Any clearance, drilling, and construction activities needed for network deployment, including noise and vibrations associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

### Marine Mammals

All of the marine mammal species (including whales) known to occur offshore of Georgia are also protected under the ESA. Noise and vibrations associated with the installation of cables in the near/offshore waters of coastal Georgia could impact marine mammal migration patterns,

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<sup>169</sup> A location chosen by an animal for hibernation.

though impacts are likely to be short-term provided the noise and vibration sources are not wide-ranging and below Level A and B sound exposure thresholds.<sup>170</sup> Marine mammals have the capacity to divert from sound sources during migration, and, therefore, impacts are expected to be *less than significant* at the programmatic level since noise and vibration -generating activities would be of short duration and are not likely to result in long-term avoidance. Environmental consequences pertaining to these species are discussed more fully in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

### Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over great distances often involving many different countries. For example, as a group, shorebirds migrating through Georgia undertake some of the longest-distance migrations of all animals. Georgia is located within the Atlantic Flyway, which spans more than 3,000 miles from the Arctic tundra to the Caribbean. Georgia has 44 IBAs throughout the state serving as important stopover, breeding, and wintering areas for migratory birds (National Audubon Society, 2007). 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 generally expected to be *less than significant* at the programmatic level. Additionally, there is some evidence in the scientific literature that RF emissions could affect bird migration. Engels et al. (2014) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise, which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. It is unlikely that the limited amount of infrastructure, the amount of RF emissions generated by Project infrastructure, and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Chapter 16, BMPs and Mitigation Measures, provides a list of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential effects to migratory pathways.

### Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate in Georgia. The Striped newt migrates out of the ponds where they were born and into the uplands where they live until they move back to ponds to breed as adults (GADNR, 2009b). Gopher frogs inhabit burrows in upland habitats. During breeding season, the gopher frog will travel a mile or more to breed and lay eggs in temporary ponds (GADNR, 2015i). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

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<sup>170</sup> Level A: 190 dB re 1 $\mu$ Pa (rms) for seals and 180 dB re 1 $\mu$ Pa (rms) for whales, dolphins, and porpoises. It is the minimum exposure criterion for injury at the level at which a single exposure is estimated to cause onset of permanent hearing loss. Level B: 160 dB re 1 $\mu$ Pa (rms). It is defined as the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (Southall, et al., 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

### Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. *No effects* to migratory patterns of Georgia's invertebrates are expected as a result of the Proposed Action.

### *Reproductive Effects*

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level (except for birds and bats which are anticipated to be *less than significant with BMPs and mitigation measures incorporated*, see below) due to the short-term and limited nature of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

### Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Georgia. For example, pregnant black bears studied in southeast Georgia use certain types of habitats (e.g., shrub, blackgum, mixed shrub, and cypress) that allow for more effective defense of their cubs from predators (USFWS, 2002).

There are no published studies that document *adverse effects* to bats from RF exposure. As stated above, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

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* at the programmatic level. Reproductive effects as a

result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

### Marine Mammals

All of the marine mammal species (including whales) known to occur offshore of Georgia are also protected under the ESA. Environmental consequences pertaining to these species are discussed in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

### Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual, vibrations, 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). Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian subjects, including embryonic mortality in bird eggs and reproductive changes in adult birds (Wyde, 2016) (Levitt & Lai, 2010) (DiCarlo, White, Guo, & Litovitz, 2002) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (DiCarlo, White, Guo, & Litovitz, 2002) (Manville, 2007). These studies suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) (see Section 2.4.2, RF Emissions and Humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, it is unclear how this exposure would affect organisms in the wild.

As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures) to help reduce bird mortalities associated with both RF emissions and tower collisions. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

The majority of FirstNet deployment or operation activities are likely to be small-scale. Applicable BMPs and mitigation measures as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 6.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

### Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the Alabama map turtle is only found in very localized areas of Georgia along the Conasauga River and in the Ridge and Valley province. “Disturbances to the natural hydrology

and water quality from impoundment, siltation, and pollution threaten the existence of native mollusks, and ultimately the Alabama map turtle” (GADNR, 2016d).

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, or alter water quality through sediment infiltration or obstruction of natural water flow to pools, though BMPs would help to avoid or minimize the potential impacts. Overall, impacts to reptiles and amphibians are expected to be *less than significant* at the programmatic level due to the limited extent and temporary nature of the deployment.

### Invertebrates

According to the GADNR, “Freshwater mussels are one of the most imperiled groups of animals in North America” (GADNR, 2016e). While many fish could move away from stretches of rivers and streams if there are disturbances, mussels will remain until they could no longer survive (GADNR, 2016e). However, the majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, no reproductive effects to invertebrates are expected as a result of the Proposed Action.

### *Invasive Species Effects*

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources. In Georgia, exotic wildlife species are regulated and GADNR must be consulted prior to acquiring any species that is not normally domesticated in Georgia.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites; although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, at the programmatic level, potential impacts are expected to be *less than significant*.

Potential invasive species effects to Georgia’s wildlife are described below.

### Terrestrial Mammals

In Georgia, feral hogs adversely impact several native large and small mammals, including squirrels and deer. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (GADNR, 2003).

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. 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16)

would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to terrestrial mammals as a result of the introduction of invasive species.

### Marine Mammals

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. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would not occur.

### Birds

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 from machinery or construction workers. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to birds as a result of the introduction of invasive species.

### Reptiles and Amphibians

Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers during deployment activities. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to reptiles and amphibians as a result of the introduction of invasive species.

### 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 invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a threat to Georgia's forest and agricultural resources. 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. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures

(see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to invertebrate species as a result of the introduction of invasive species.

### **Potential Impacts of the Preferred Alternative**

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including 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 at the programmatic level, from *no impacts* to *less than significant with BMPs and mitigation measures incorporated*, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibrations generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. At the programmatic level, it is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have *no impacts* to wildlife resources at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
  - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellites launched for other purposes, and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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* on wildlife resources.

#### Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure 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 and vibrations, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water and construction of landings and/or facilities on the shores or

the banks of waterbodies that accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 6.2.4, 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 indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise and vibration disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise and vibrations. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be *less than significant* at the programmatic level given the small scale of likely individual FirstNet projects with the exception of impacts to birds and bats, which are expected to be *less than significant with BMPs and mitigation measures incorporated*. Some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and are therefore expected to remain *less than significant* at the programmatic level. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be *less than significant* impacts to wildlife resources at the programmatic level associated with routine inspections of the Preferred Alternative. Site maintenance would be infrequent, including mowing or limited application of herbicides, and 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. Potential spills of these materials would be expected to be in small quantities.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. In particular, collisions with new cell towers that may be installed as part of the Preferred Alternative could increase avian mortality. As stated above, these impacts would likely be limited to individual wildlife species. DOI comments dated October 11, 2016<sup>171</sup> state communication towers are "currently estimated to kill between four and five million birds per year" (Regulations.gov, 2016). Although collisions with towers have the potential to impact a large number of birds unless BMPs and

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<sup>171</sup> See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Therefore, impacts to birds may be *less than significant with BMPs and mitigation measures added*.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore, would likely be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Alternatives Impact Assessment**

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

#### *Deployable Technologies Alternative*

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this Alternative could be as described below.

#### Deployment Impacts

As described above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. Chapter 16, BMPs and Mitigation Measures,

provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *No Action Alternative*

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to wildlife resources as a result of the No Action Alternative. Therefore, environmental conditions would be the same as those described in Section 6.1.6.4, Terrestrial Wildlife.

### **6.2.6.5. Fisheries and Aquatic Habitats**

Impacts to fisheries and aquatic habitats occurring in Georgia and Georgia's near offshore environment are discussed in this section. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## **Description of Environmental Concerns**

### *Direct Injury/Mortality*

The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 6.2.6-1, *less than significant* impacts would be anticipated at the programmatic level given that the majority of the proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, 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*

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. Therefore, at the programmatic level, potential impacts are expected to be *less than significant*. Additionally, deployment activities with the potential for impacts under the MSFCMA or other sensitive aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

### *Indirect Injury/Mortality*

Erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could have potential impacts on water quality. Exposure to contaminants from accidental spills from vehicles and equipment could also potentially affect water quality. These potential effects could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. Nonetheless, these impacts are expected to be *less than significant* at the programmatic level due to the short-term nature and limited geographic scope of deployment activities. BMPs and mitigation measures to protect water resources (see Section 6.2.4, Water Resources) could help to minimize or avoid potential impacts.

### *Effects to Migration or Migratory Patterns*

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and at a small scale, and therefore are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

### *Reproductive Effects*

Reproductive effects are those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration,

obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and, therefore, at the programmatic level, impacts expected to be *less than significant*. BMPs and mitigation measures could help to further avoid or minimize any potential impacts.

### *Invasive Species Effects*

FirstNet deployment activities could result in *less than significant* impacts to aquatic populations at the programmatic level due to introduction of invasive species. The potential to introduce invasive plant (and plant seeds) and pest species (e.g., invasive insects) within construction zones could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. FirstNet deployment activities could result in short-term or temporary changes to specific project sites however, these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Overall, these potential impacts are expected to be *less than significant* at the programmatic level due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive species during implementation of the Proposed Action as well as minimize effects to fisheries and aquatic habitats as a result of the introduction of invasive species. Should invasive species be found on a site, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented to minimize invasive species effects to fisheries and aquatic species.

## **Potential Impacts of the Preferred Alternative**

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including 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, at the programmatic level, 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. Chapter 16, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to fisheries and aquatic habitats under the conditions described below:

- **Wired Projects**
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibrations, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries and aquatic habitats would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to fisheries and aquatic habitats at the programmatic level because there would be no ground disturbance.
- **Satellites and Other Technologies**
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact 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, at the programmatic level, this activity would have *no impact* on the aquatic environment.

### Activities with the Potential to Have Impacts at the Programmatic Level

Potential/deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- **Wired Projects**
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. BMPs and mitigation measures could help avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private

- easements as well as the construction of access roads, POPs, huts, or 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 shores or the banks of waterbodies that accept submarine cables could result in direct injury/mortalities of fisheries and aquatic invertebrates that are not mobile enough to avoid construction activities (e.g., mussels), that utilize burrows (e.g., crayfish), or that are defending nest sites. Disturbance, including noise and vibrations, 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. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of RF 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be *less than significant* at the programmatic level due to the small scale and localized nature of deployment activities that have the potential to impacts aquatic habitats. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated, at the programmatic level, that there would be *less than significant* impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that might include accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to result, at the programmatic level, 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 habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of

invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be *less than significant* at the programmatic level due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Alternatives Impact Assessment**

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

#### *Deployable Technologies Alternative*

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this Alternative could be as described below.

#### Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level from habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* at the programmatic level due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### Operational Impacts

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, the impacts could vary greatly among species and geographic region, but they are expected to remain *less than significant* despite this potential variability. Nonetheless, at the programmatic level, it is

anticipated that there would be *less than significant* impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *No Action Alternative*

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to fisheries and aquatic habitats as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.6.5, Fisheries and Aquatic Habitats.

#### **6.2.6.6. Threatened and Endangered Species**

This section describes potential impacts to threatened and endangered species in Georgia and Georgia's inland and offshore environment associated with deployment and operation of the Proposed Action and alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

#### **Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 6.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect, likely to adversely affect*; *may affect, not likely to adversely affect*; and *no effect*. These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (USFWS, 1998b):

- *No effect* means that no listed resources would be exposed to the action and its environmental consequences.
- *May affect, not likely to adversely affect* means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any *adverse effects* to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.
- *May affect, likely to adversely affect* means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

At the programmatic level, 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 6.2.6-2, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has the potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, may affect and likely adversely affect a listed species. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Georgia are described below. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

**Table 6.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under <i>likely to adversely affect</i> category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the <i>likely to adversely affect</i> threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large-scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale, but have a large <i>adverse effect</i> on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to infrequent, temporary, or short-term changes.	

### Terrestrial Mammals

There are two endangered and one threatened terrestrial mammal species federally listed and known to occur in the state of Georgia; they are the gray bat, Indiana bat, and northern long-eared bat.

Direct mortality or injury to the federally listed Indiana bat or northern long-eared bat could occur if tree clearing activities occurred at roosting sites while bats were present (USFWS, 2012a) (USFWS, 2015I). Direct mortality or injury to the federally listed gray bat could occur if caves were flooded or blocked off while bats were present (USFWS, 1997a) (USFWS, 2008e). 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 effects to these species; when disturbed by noise, vibrations, or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997a). Impacts would likely be isolated, individual events and therefore *may affect, but are not likely to adversely affect*, listed terrestrial mammal species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Marine Mammals

Three endangered whale species and one endangered manatee species are known to occur in Georgia's near offshore environment. They are the finback whale, humpback whale, northern Atlantic right whale, and the West Indian manatee. Direct injury or mortality to these species could occur from entanglements from marine debris as well as ingestion of marine debris, but are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed marine mammal species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Birds

One endangered and three threatened bird species are federally listed and known to occur in the state of Georgia; they are the red-cockaded woodpecker, piping plover, red knot, and wood stork. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts *may affect, but are not likely to adversely affect*, listed bird species as FirstNet would attempt to avoid deployment activities in areas where they are known to rest. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs

and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Fish

Five endangered and four threatened fish species are federally listed and known to occur in Georgia; they are the amber darter, Conasauga logperch, Etowah darter, shortnose sturgeon, smalltooth sawfish, blue shiner, goldline darter, Cherokee darter, and snail darter. Direct mortality or injury to this species could occur from entanglements resulting from the Proposed Action, but are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts *may affect, but are not likely to adversely affect*, listed fish species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Reptiles and Amphibians

One endangered and one threatened amphibian species are federally listed and known to occur in the state of Georgia. They are, respectively, the reticulated flatwoods salamander and the frosted flatwoods salamander. Direct mortality to these species could occur in construction zones either by excavation activities or by vehicle strikes. Potential effects would likely be isolated, individual events, and FirstNet would attempt to avoid areas where these species may occur. Therefore, potential impacts *may affect, but are not likely to adversely affect*, the listed amphibian species.

One threatened terrestrial reptile species is federally listed and known to occur in the state of Georgia: the eastern indigo snake. Direct mortality to the eastern indigo snake could occur in construction zones either by excavation activities or by vehicle strikes. Potential effects would likely be isolated, individual events, and FirstNet would attempt to avoid areas where these species may occur. Therefore, potential impacts *may affect, but are not likely to adversely affect*, the listed reptile species.

Three endangered and one threatened marine reptile species are also known to occur in the coastal area and offshore environment of Georgia; they are, respectively, the hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle. The leatherback sea turtle and loggerhead sea turtle are known to nest in Georgia. Direct mortality or injury occurring from accidental trampling at nest sites if eggs are present during the Proposed Action are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts may affect, but would not likely adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Invertebrates

There are 12 endangered and three threatened invertebrate species that are federally listed and known to occur in the state of Georgia, as summarized in Table 6.1.6-9. Fourteen of these federally listed species are mussels, and one is an aquatic snail. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to federally listed mussels and the Georgia interrupted rocksnail are unlikely but could occur from changes in water quality from ground disturbing activities causing stress and lower productivity resulting from the Proposed Action. Potential impacts *may affect, but are not likely to adversely affect*, the listed invertebrate species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Plants

Nineteen endangered and eight threatened plant species are federally listed and known to occur in the state of Georgia, as summarized in Table 6.1.6-10. Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid areas where these species may occur; therefore, potential impacts *may affect, but are not likely to adversely affect*, listed plant species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### *Reproductive Effects*

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species 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, marine mammals, birds, terrestrial reptiles and marine reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Georgia are described below.

### Terrestrial Mammals

Noise, vibrations, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals within or in the vicinity of project activities. For example, while projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when species such as the gray bat are present could lead to effects to these species; when disturbed by noise, and vibrations, or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (USFWS, 1997a). Impacts would be directly related to the frequency, intensity, and duration of these activities; however, they are anticipated to be small-scale and localized. FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely*

*affect*, listed terrestrial mammal species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Marine Mammals

The three federally listed whale species are found in the offshore areas of Georgia are migrants. Therefore, no long-term reproductive effects to federally listed marine mammals are expected as a result of the Proposed Action.

The West Indian manatee often uses secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving (USFWS, 2001a). Noise, vibrations, light, and other human disturbances associated with the Proposed Action could affect manatees within or in the vicinity of Project activities, but are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed marine mammal species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Birds

Noise, vibrations, light, or other 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. For example, any activity that results in impacts to the piping plover, which nests in open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers (USFWS, 1988). FirstNet would attempt to avoid these areas; the majority of FirstNet deployment activities would not occur on beaches or native grasslands; therefore, impacts to these bird species are not anticipated. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed bird species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise, vibrations), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 6.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in Georgia, such as the amber darter, are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid those areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed fish species. BMPs and mitigation measures, as defined through consultation with the appropriate

resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Reptiles and Amphibians

Three of the five federally listed sea turtles found in the offshore areas of Georgia use Georgia's beaches or barrier islands as nesting habitat. According to the GADNR, "the loggerhead is the only species to nest regularly on the state's barrier islands" (GADNR, 2015i). Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. Further, land clearing activities, noise, vibrations, and other human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. FirstNet would attempt to avoid these areas. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed reptile or amphibian species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Invertebrates

Changes in water quality from ground disturbing activity could cause stress resulting in lower productivity for federally listed mussels and aquatic snail species known to occur in Georgia. In addition, introduction of invasive aquatic species could indirectly affect mussels as a result of fish populations that they rely on for their reproductive cycle being altered (USFWS, 2012b). Potential impacts to federally listed invertebrate species, at the programmatic level, *may affect, but are not likely to adversely affect*, those invertebrate species, as FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Plants

Potential impacts could occur from ground-disturbing activities to listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect, but are not likely to adversely affect*, these plant species at the programmatic 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 16, may be implemented as appropriate to further minimize potential impacts.

### *Behavioral Changes*

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered *potentially significant*. Potential effects to federally listed terrestrial mammals, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Georgia are described below.

#### Terrestrial Mammals

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect breeding and foraging sites of the federally listed terrestrial mammals, such as the Indiana bat, resulting in reduced survival and productivity. However, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed terrestrial mammals. Ground disturbing activities could impact food sources for the federally listed terrestrial mammals in Georgia. Further, increased human disturbance, noise, vibrations, and vehicle traffic could cause stress to these species causing them to abandon breeding locations or alter migration patterns. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these federally listed bat species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

#### Marine Mammals

Noise and vibrations associated with the installation of cables in the near/offshore waters of coastal Georgia could affect marine mammal migration patterns, though impacts are likely to be short-term provided the noise and vibration sources are not wide ranging and below Level A and Level B sound exposure thresholds. Marine mammals, such as the finback whale, have the capacity to divert from sound sources during migration. The majority of FirstNet deployment projects would not occur in an aquatic environment; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, listed marine mammal species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

#### Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over long distances often involving many different countries. For example, the red knot has been found to fly up to 9,300 miles from their breeding and wintering sites and often return to the same sites year and after year in Georgia. Disturbance in stopover, foraging, or breeding areas (visual, vibrations, 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 effects federally listed birds. FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, these bird species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Fish

Changes in water quality could impact food sources for the federally fish species in Georgia. Further, increased human disturbance, noise, vibrations, and vessel traffic could cause stress to these species, such as activities causing the blue shiner to abandon spawning locations or altering migration patterns. Behavioral changes to these listed species are unlikely as the majority of FirstNet deployment projects would not occur in aquatic environment. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, these fish species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of the federally listed reptile species, resulting in reduced survival and productivity; however, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed reptiles or amphibians. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these listed reptile and amphibian species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed mussels resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact foraging behavior. FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts may affect, but would likely not adversely affect, these invertebrate species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

## Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

### *Loss or Degradation of Designated Critical Habitat*

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an *adverse effect* and could be *potentially significant*. Depending on the species or habitat, the *adverse effect* threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to *potentially significant* effects, such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed marine mammals, birds, fish, reptiles and amphibians, invertebrates, and plants with designated critical habitat in Georgia.

## Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Georgia. 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.

## Marine Mammals

One of the federally endangered marine mammals in Georgia has federally designated critical habitat. Critical habitat for the North Atlantic right whale was designated from the shoreline out 5-15 nautical miles between the mouth of the Altamaha River and down to Florida. The installation of cables in limited nearshore and construction of landings and/or facilities on the shore to accept submarine cables could potentially affect threatened and endangered species and their habitat where the shoreline begins. However, the majority of FirstNet deployment activities would not occur in an aquatic environment; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, designated critical habitat for the North Atlantic right whale. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

## Birds

One of the federally listed bird species in Georgia has federally designated critical habitat. Critical habitat for the piping plover has been designated along Georgia's barrier islands. FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts may affect, but would likely not adversely affect, designated critical habitat for the piping plover. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Fish

Two of the federally listed fish species in Georgia have federally designated critical habitat. Critical habitat for amber darter and Conasauga logperch was designated in the Conasauga River in Murray and Whitfield Counties, Georgia. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water and therefore would not likely disturb critical habitat. FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, designated critical fish habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Reptiles and Amphibians

Two of the federally listed amphibians and reptiles in Georgia have federally designated critical habitat. Critical habitat for the loggerhead sea turtle was designated along Georgia's barrier islands. Critical habitat for the reticulated flatwoods salamander in Georgia consists of two areas totaling 784 acres in Miller and Baker Counties.

Land clearing, excavation activities, and other ground disturbing activities in this region of Georgia could lead to habitat loss or degradation, which could lead to effects to the loggerhead sea turtle and reticulated flatwoods salamander depending on the duration, location, and spatial scale of the associated activities. The majority of FirstNet deployment projects would not occur in an aquatic environment, and FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts may affect, but would likely adversely affect, designated critical reptile or amphibian habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### Invertebrates

Critical habitat has been designated for all 15 of the federally listed invertebrate species in Georgia. Changes to water quality from ground disturbing activities in these regions of Georgia could lead to habitat loss or degradation for federally listed mussels and the Georgia interrupted rocksnail, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. The majority of FirstNet deployment projects would not occur in an aquatic environment, and FirstNet would attempt to avoid areas where these species are known to occur. Therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, designated critical habitat for listed invertebrates. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

## Plants

Two of the federally listed plant species in Georgia have federally designated critical habitat. Critical habitat for the Georgia rockcress exists in Clay, Floyd, Gordon, Harris, and Muscogee Counties. Critical habitat for the whorled sunflower exists in Floyd County.

Land clearing, excavation activities, and other ground disturbing activities in these regions of Georgia could lead to habitat loss or degradation, which affect these plants depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, at the programmatic level, potential impacts *may affect, but are not likely to adversely affect*, designated critical habitat for listed plants. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### **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, at the programmatic level, in a range of *no impacts to less than significant* impacts, depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

#### Activities Likely to Have No Effect at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no effect* on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibrations, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed

- areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to threatened and endangered species or their habitat at the programmatic level 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 and endangered because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have *no impact* on protected species at the programmatic level.

#### Activities with the Potential to Affect Listed Species at the Programmatic Level

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential 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., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise and vibrations, 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 and vibration disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shores or the banks of waterbodies that accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 6.2.4, 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 at the programmatic level. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.
  - Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower; 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions.

- Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise and vibration disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but are not likely adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### *Operation Impacts*

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts.

It is anticipated that operational impacts *may affect, but are not likely to adversely affect* threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, *may affect, but are not likely to adversely affect* threatened and endangered species, as they would be conducted infrequently, and BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet

would attempt to avoid areas where these species are known to occur. Therefore, listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### **Alternatives Impact Assessment**

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

#### *Deployable Technologies Alternative*

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this Alternative could be as described below.

#### Deployment Impacts

As explained above, implementation of deployable technologies *may affect, but is not likely to adversely affect*, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

## Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that 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. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

### *No Action Alternative*

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effect* to threatened and endangered species as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.6.6, Threatened and Endangered Species and Species of Concern.

## **6.2.7. Land Use, Recreation, and Airspace**

### **6.2.7.1. Introduction**

This section describes potential impacts to land use, recreation, and airspace resources in Georgia associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.7.2. 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 6.2.7-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

**Table 6.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, vibrations, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

### **6.2.7.3. 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 ROW, 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 6.2.7-1, at the programmatic level, *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 aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 6.2.7-1, *less than significant* impacts would be anticipated at the programmatic level as any new land use would be small-scale; only short-term impacts during the construction phase would be expected.

### **Loss of Access to Public or Private Recreation Land or Activities**

The deployment, operation, and maintenance of facilities and the acquisition of ROW or easement could influence access to public or private recreation land or activities. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 6.2.7-1, *less than significant* impacts would be anticipated at the programmatic level, as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

### **Loss of Enjoyment of Public or Private Recreation Land**

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise and vibration impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 6.2.7-1, *less than significant* impacts at the programmatic level would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

### **Use of Airspace**

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Potential impacts could include air routes or flight paths, available flight altitudes, disruption of normal flight patterns, and restrictions to flight activities. Construction of new towers or alternations to existing towers could obstruct navigable airspace depending on the tower location. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 6.2.7-1, 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 be unlikely to have a significant impact on airspace resources. Therefore, the potential impacts to Airspace is expected to be *less than significant* at the programmatic level.

### *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, at the programmatic level, in a range of *no impacts* to *less than significant impacts* depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no 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.
    - **Land Use:** See *Activities with the Potential to Have Impacts* below.
    - **Recreation:** See *Activities with the Potential to Have Impacts* below.
    - **Airspace:** *No impacts* to airspace at the programmatic level 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 6.1.7.6 *Obstructions to Airspace Considerations*).
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - **Land Use:** It is anticipated that there would be *no impacts* to land use at the programmatic level would since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - **Recreation:** See *Activities with the Potential to Have Impacts* below.
    - **Airspace:** It is anticipated that there would be *no impacts* at the programmatic level would 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 6.1.7.6 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.
    - Land Use: See *Activities with the Potential to Have Impacts* below.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: Installation of new poles would *no impact* at the programmatic level would on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
  - Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level would 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 at the programmatic level 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 at the programmatic level would from collocations.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level would to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would *not impact* recreation at the programmatic level would because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have *no impacts* at the programmatic level would to 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 shores or the banks of waterbodies that accept submarine cable.
    - Land Use: See *Activities with the Potential to Have Impacts* below.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would *not impact* at the programmatic level would 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 6.1.7.6 Obstructions to Airspace Considerations).
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below

- addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
- Land Use: See *Activities with the Potential to Have Impacts* below.
  - Recreation: See *Activities with the Potential to Have Impacts* below.
  - Airspace: *No impacts* at the programmatic level would to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Wireless Projects
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
      - Land Use: There would be *no impacts* at the programmatic level would 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 with the Potential to Have Impacts* below.
      - Airspace: See *Activities with the Potential to Have Impacts* below.
  - Deployable Technologies
    - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
      - Land Use: It is anticipated that there would be *no impacts* at the programmatic level would to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
      - Recreation: *No impacts* at the programmatic level would to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
      - Airspace: See *Activities with the Potential to Have Impacts* below.
  - Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
      - Land Use: It is anticipated that there would be *no impacts* at the programmatic level existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
      - Recreation: See *Activities with the Potential to Have Impacts* below.
      - Airspace: See *Activities with the Potential to Have Impacts* below.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, recreation, or airspace, it is

anticipated that this activity would have *no impact* at the programmatic level on land use, recreation, or airspace.

### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- **Wired Projects**
  - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road 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* at the programmatic level would be anticipated – see previous section.
  - **New Build – Aerial Fiber Optic Plant:** Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - **Land Use:** These activities could result in *potential impacts* at the programmatic level to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.
    - **Recreation:** Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - **Airspace:** *No impacts* at the programmatic level would be 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 shores or the banks of waterbodies that accept submarine cable.
    - **Land Use:** Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have

- long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
- Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
  - Airspace: *No impacts* at the programmatic level would be anticipated – see previous section.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
    - Airspace: *No impacts* at the programmatic level would be anticipated – see previous section.
  - Wireless Projects
    - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
      - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
      - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
      - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets other criteria listed in Section 6.1.7.6 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 Georgia's airports.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.

- Land Use: *No impacts* at the programmatic level would be anticipated – see previous section.
- Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
- Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: *No impacts* at the programmatic level would be anticipated – see previous section.
    - Recreation: *No impacts* at the programmatic level would be 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 Georgia airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: *No impacts* at the programmatic level would be anticipated – see previous section.
    - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be *no impacts* at the programmatic level would to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for inspections.

The degree of change in the visual environment (see Section 6.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. Once deployment locations are known, the location would be subject to an environmental review to help ensure environmental concerns are identified. The use of deployable aerial communications architecture could temporarily add new air traffic or aerial navigation hazards. The magnitude of these effects would depend on the specific location of airborne resources along with the duration of their use. FirstNet would coordinate with the FAA to review required certifications. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.7.4. Alternatives Impact Assessment**

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

##### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this Alternative could be as described below.

##### *Deployment Impacts*

As explained above, at the programmatic level, implementation of deployable technologies could result in *less than significant* impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected; however, impacts would be *less than significant* at the programmatic level would due to the temporary nature of likely deployment activities. If deployment triggers any obstruction criterion or result in changes to flight patterns and airspace restrictions, FirstNet (or its partners) would consult with the FAA to determine how to proceed. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

##### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level would to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be

the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be *less than significant* at the programmatic level due to the temporary nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level would to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 6.1.7, Land Use, Recreation, and Airspace.

## **6.2.8. Visual Resources**

### **6.2.8.1. Introduction**

This section describes potential impacts to visual resources in Georgia associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.8.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 6.2.8-1. As described in Section 6.2, Environmental Consequences, the categories of impacts at the programmatic level are defined as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

**Table 6.2.8-1: Impact Significance Rating Criteria for Visual Resources at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

### **6.2.8.3. 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 Georgia, residents and visitors travel to many national monuments, historic sites, and state parks, to view its scenic coast and beaches, for recreation. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 6.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. The majority of FirstNet deployment activities would not cause negative impacts to the aesthetic character to a noticeable degree. However, some projects, such as towers, facilities, or infrastructure could cause a negative impact on the aesthetic character of local viewsheds depending on their size and location. However, given the small scale of likely FirstNet activities, impacts are expected to be *less than significant* at the programmatic level.

#### **Nighttime Lighting**

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered *potentially significant* at the programmatic level.

Based on the impact significance criteria presented in Table 6.2.8-1, at the programmatic level, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term would be considered *potentially significant*. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience *potentially significant* impacts to night skies, although potentially minimized to *less than significant* at the programmatic level with implementation of BMPs and mitigation measures, as defined in Chapter 16, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

### **6.2.8.4. 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, at the programmatic level, in a range of *no impacts* to *less than significant impacts with BMPs and mitigation measures incorporated* depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure 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 and would result in *no impacts* to visual resources at the programmatic level.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* at the programmatic level to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to visual resources at the programmatic level because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* visual resources at the programmatic level since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have *no impact* on visual resources at the programmatic level.

### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- **Wired Projects**
  - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development 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 poles or replacements 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, *potentially significant* 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 at the programmatic level. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that 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 temporary and localized and are anticipated to be *less than significant* at the programmatic level.
- **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 be *potentially significant* at the programmatic level.

- 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 likely have *no impact* on visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction 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* at the programmatic level due to the temporary and small-scale nature of deployment activities. As discussed above, potential impacts to night skies from lighting are expected, at the programmatic level, to be *less than significant with BMPs and mitigation measures incorporated*. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* at the programmatic level to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be *less than significant at the programmatic level with BMPs and mitigation measures incorporated* during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.8.5. 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* at the programmatic level, as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be *less than significant* at the programmatic level given the limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to visual resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.8, Visual Resources.

## **6.2.9. Socioeconomics**

### ***6.2.9.1. Introduction***

This section describes potential impacts to socioeconomics in Georgia associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### ***6.2.9.2. Impact Assessment Methodology and Significance Criteria***

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 6.2.9-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

**Table 6.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible impact to property values and/or rental fees.	<i>No impacts</i> to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations and as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Indiscernible economic change.	No change to tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns locations and , as opposed to throughout the state or territory..	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns locations and , as opposed to throughout the state or territory..	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations locations and , as opposed to throughout the state or territory..	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

### **6.2.9.3. 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.

#### **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 Georgia. Median values of owner-occupied housing units in the 2009–2013 period ranged from just under \$175,000 in the greater Atlanta area, to just over \$114,000 in Macon. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic 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 contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to \$7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary 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* at the programmatic level. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility

tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006a). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

### **Impacts to Employment**

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor, direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet's partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage-earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and *less than significant* at the programmatic level. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across Georgia. The average unemployment rate in 2014 was 7.2 percent, considerably higher than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were located in the central part of the northern portion of the state, with some counties dispersed around the state. All other counties had unemployment rates above the national average. High unemployment rates were particularly prevalent in the southern half 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 6.2.9-1 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 can 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.

#### ***6.2.9.4. Potential Impacts of the Preferred Alternative***

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

### **Deployment Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 6.2.9-1. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Activities Likely to Have No Impacts at the Programmatic Level*

- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have *no impact* at the programmatic level on socioeconomic resources.

### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For 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* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be

- small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited 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* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
  - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
  - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be *less than significant* at the programmatic level.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:

- Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise and vibrations, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be *less than significant* at the programmatic level.
- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

In general, at the programmatic level, the abovementioned activities would have *less than significant* beneficial socioeconomic 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* at the programmatic level. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be *less than significant* at the programmatic level, as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

## Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. Public or private sector employees would conduct all operational activities, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity, and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a *less than significant* number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be *less than significant* at the programmatic level as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.9.5. Alternatives Impact Assessment**

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

#### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger

geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this Alternative could be as described below.

### *Deployment Impacts*

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and, therefore, *less than significant* at the programmatic level.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. The potential impacts are anticipated to be *less than significant* at the programmatic level as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Impacts*

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be *less than significant* at the programmatic level.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise, vibrations, and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be *less than significant* at the programmatic level as they would be limited to a relatively small number of sites within the region and Georgia. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to socioeconomics from the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 6.1.9, Socioeconomics.

## **6.2.10. Environmental Justice**

### ***6.2.10.1. Introduction***

This section describes potential impacts to environmental justice in Georgia associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### ***6.2.10.2. Impact Assessment Methodology and Significance Criteria***

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 6.2.10-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, *as potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

**Table 6.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects associated with other resource areas (e.g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and <i>adverse effects</i> on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level locations and , as opposed to throughout the state or territory..	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

### **6.2.10.3. Description of Environmental Concerns**

#### **Effects associated with other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations**

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, “Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment” (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise and Vibrations, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, vibrations, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). See Socioeconomics Environmental Consequences for additional discussion. The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* “adverse” and “disproportionately high” in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on *adverse effects*. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 6.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

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 (Section 6.1.10) as

having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 6.1.10.3, Environmental Setting: Minority and Low-Income Populations, Georgia has a considerably higher percentage of Black/African American population than the region or nation. It also has a higher percentage of All Minorities than the region or nation. The poverty rate Georgia is higher than that of the region and considerably higher than that of the nation. Georgia has many areas with high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas, such as areas across the central part of the state. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state, with somewhat higher prevalence in the north. Further analysis using the data developed for the screening analysis in Section 6.1.10.4, 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, 2016j).

Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Analysts could 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.

#### ***6.2.10.4. Potential Impacts of the Preferred Alternative***

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

#### **Deployment Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts at the programmatic level depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### ***Activities Likely to Have No Impacts at the Programmatic Level***

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to environmental justice under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, at the programmatic level, they would have *no impact* on environmental justice communities.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have *no impacts* to environmental justice. If physical access were required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with *no impact* at the programmatic level on environmental justice communities.
- **Satellites and Other Technologies**
  - **Satellite-Enabled Devices and Equipment:** It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
  - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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 at the programmatic level, it is anticipated that this activity would have *no impact* on environmental justice.

*Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, vibrations, 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, vibrations, 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, vibrations, 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 or on the banks of waterbodies that accept submarine cable could temporarily generate noise, vibrations, 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, vibrations, 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, vibrations, 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, vibrations, and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise, vibrations, 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, vibrations, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be *less than significant* at the programmatic level, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. Furthermore, site-specific analysis could evaluate site conditions and the impacts of the type of deployment, and could satisfy requirements associated with any other permits or permissions necessary to perform the work. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of 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, vibrations, and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.10.5. 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, vibrations, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level, because they would be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Impacts*

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, vibrations, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level, as operations are expected to be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to environmental justice communities as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.10, Environmental Justice.

## **6.2.11. Cultural Resources**

### ***6.2.11.1. Introduction***

This section describes potential impacts to cultural resources in Georgia associated with deployment and operation of the Proposed Action and alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### ***6.2.11.2. Impact Assessment Methodology and Significance Criteria***

The impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 6.2.11-1. The categories of impacts are defined at the programmatic level as an *adverse effect*; *mitigated adverse effect*; *effect, but not adverse*; and *no effect*. These impact categories are comparable to those defined in 36 *CFR* § 800, Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (NPS, 1983), and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (NPS, 2002). Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential effect on cultural resources addressed in this section are presented as a range of possible effects.

**Table 6.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level**

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect <sup>a</sup>	Effect, but not Adverse	No Effect
Physical damage to and/or destruction of historic properties <sup>b</sup>	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects area of potential effect (APE).		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.

Type of Effect	Effect Characteristics	Effect Level			
		Adverse Effect	Mitigated Adverse Effect <sup>a</sup>	Effect, but not Adverse	No Effect
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	<i>Adverse effect</i> that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

<sup>a</sup> Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is “Less than Significant with Mitigation Measures Incorporated,” historic properties are considered to be “non-renewable resources,” given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the GASHPO/Tribal Historic Preservation Office (THPO) and other consulting parties, including American Indian tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

<sup>b</sup> Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

### **6.2.11.3. 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 6.2.11-1, at the programmatic level, direct deployment impacts could have potentially *adverse effects* 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 Georgia, some deployment activities may be in these areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential impacts.

#### **Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)**

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially *adverse effects* from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

#### **Loss of Character Defining Attributes of Historic Properties**

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such 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. *Adverse effects* such as these could be avoided or minimized through BMPs (see Chapter 16).

#### **Loss of Access to Historic Properties**

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of *adverse effect* would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to American Indians. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

#### **6.2.11.4. Potential Effects of the Preferred Alternative**

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

#### **Deployment Effects**

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, at the programmatic level, in a range of *no effect to potentially adverse effect* depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Activities Likely to Have No Effect at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are 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 effect* on cultural resources at the programmatic level 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 effect* on cultural resources at the programmatic level. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have *no effect* on cultural resources at the programmatic level 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 have *no effect* on 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 effect* on cultural resources at the programmatic level.

### *Activities with the Potential to Have Effects at the Programmatic Level*

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of effects 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 effects on 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 POPs, 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 in the coastal areas of Georgia where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) and have the potential to contain submerged archaeological sites. Impacts to cultural resources could also potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological and historic sites (archaeological deposits are frequently associated with bodies of water), and the associated structures could have visual effects on historic properties.
  - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no effect* on cultural resources at the programmatic level. However, there could be potentially *adverse effects* to cultural resources if installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads. 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 Savannah 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 effects on cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect effects including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could *affect, but not adversely affect*, cultural resources as the potential *adverse effects* would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Effects**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in effects similar to the abovementioned deployment effects. It is anticipated that there would be *no effect* to cultural resources associated with routine inspections

of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### ***6.2.11.5. Alternatives Effect Assessment***

The following section assesses potential effects on cultural resources associated with the Deployable Technologies Alternative and the No Action Alternative.

#### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this Alternative could be as described below.

#### *Deployment Effects*

As explained above, implementation of deployable technologies could result in effects on 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 effects on archaeological sites. These activities could *affect, but not adversely affect*, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Effects*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no *adverse effects* to historic properties associated with implementation/running of the deployable technology. No *adverse effects* would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be *no effects* to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no effects* on cultural resources as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.11, Cultural Resources.

## **6.2.12. Air Quality**

### **6.2.12.1. Introduction**

This section describes potential impacts to Georgia's air quality from deployment and operation of the Proposed Action and Alternatives. Mitigation measures, as defined through permitting and/or consultation with the appropriate resource agency, would be implemented as part of deployment and operation of the Proposed Action to help avoid or reduce potential impacts to air quality. Implementation of best management practices (BMPs), as practicable or feasible, could further reduce the potential for impacts. Both mitigation measures and BMPs are discussed in Chapter 16, BMPs and Mitigation Measures.

### **6.2.12.2. Impact Assessment Methodology and Significance Criteria**

The impacts of the Proposed Action on Georgia's air quality were evaluated using the significance criteria presented in Table 6.1.12-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to Georgia's air quality addressed in this section are presented as a range of possible impacts.

**Table 6.2.12-1: Impact Significance Rating Criteria for Air Quality at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased air emissions	Magnitude or Intensity	Emissions would prevent progress toward meeting one or more NAAQS in nonattainment areas. Emissions in attainment or maintenance areas would cause an exceedance for any NAAQS. Emissions exceed one or more major source permitting thresholds. Projects do not conform to SIP.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	Negligible emissions would occur for any pollutant within an attainment area, but would not cause a NAAQS exceedance and would not trigger major source permitting.	Emission increases would be infrequent or absent, mostly immeasurable; projects conform to SIP.
	Geographic Extent/Context	NA		NA	
	Duration or Frequency	Permanent or long-term.		Short term.	

NA = Not Applicable

### **6.2.12.3. Description of Environmental Concerns**

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* at the programmatic level due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Georgia that are in maintenance or nonattainment for one or more criteria pollutants, particularly, PM and ozone are state-wide issues (see Section 6.1.12, Air Quality). The majority of the counties in Georgia are designated as nonattainment or maintenance areas for one or more of the following pollutants: PM and ozone (Figure 6.1.12-1); counties located around Atlanta and Marietta in the northern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Figure 6.1.12-1).

Based on the significance criteria presented in Table 6.2.12-1, air emission impacts would likely be *less than significant* at the programmatic level given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. *Less than significant* emissions could occur at the programmatic level for any of the criteria pollutants within attainment areas in Georgia; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout portions of Georgia (Figure 6.1.12-1), and because infrastructure could be deployed in these areas, BMPs and mitigation measures (see Chapter 16, BMPs and Mitigation Measures) could help avoid or minimize potential air quality impacts. In addition, it is anticipated that any air pollution increase due to deployment would likely be short-term with pre-existing air quality levels generally achieved after some months (typically less than a year, and could be as short as a few hours or days for some activities such as pole construction).

### **6.2.12.4. Potential Impacts of the Preferred Alternative at the Programmatic Level**

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

#### **Potential Deployment and Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment

requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range, at the programmatic level, from *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to air quality at the programmatic level under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- **Satellites and Other Technologies**
  - **Satellite Enabled Devices and Equipment:** The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to *no impact* at the programmatic level on ambient air quality concentrations.
  - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have *no impact* on those resources at the programmatic level.

#### *Activities with Potential Impacts at the Programmatic Level*

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be *less than significant* at the programmatic level due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- **Wired Projects**
  - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
  - **New Build – Aerial Fiber Optic Plant:** The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
  - **Collocation on Existing Aerial Fiber Optic Plant:** Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
  - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited 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 shores or the banks of waterbodies that accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - **Installation of Optical Transmission or Centralized Transmission Equipment:** Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- **Wireless Projects**
  - **New Wireless Communication Towers:** Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducting excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - **Collocation on Existing Wireless Tower, Structure, or Building:** Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
- **Deployable Technologies**
  - The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate

products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be *less than significant* at the programmatic level, due to the limited nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Potential Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. At the programmatic level, it is anticipated that there would be *less than significant* impacts to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be *less than significant* at the programmatic level as they would still be limited in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.12.5. Alternatives Impact Assessment**

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

### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred

Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are described in the following sections.

### *Potential Deployment and Operation Impacts to Air Quality*

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be *less than significant* at the programmatic level, based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations, would dictate the concentrations and associated impacts. Additionally, at the programmatic level, 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. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient air quality. 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.

## **6.2.13. Noise and Vibration**

### ***6.2.13.1. Introduction***

This section describes potential noise and vibration impacts in Georgia from deployment and operation of the Proposed Action and Alternatives in Georgia. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### ***6.2.13.2. Impact Assessment Methodology and Significance Criteria***

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Table 6.2.13-1. As described in Section 6.2, Environmental Consequences,

the categories of impacts are defined, at the programmatic level, as *potentially significant, less than significant with mitigation measures incorporated, less than significant, or no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential noise and vibration impacts to Georgia addressed in this section are presented as a range of possible impacts.

### **6.2.13.3. Description of Environmental Concerns**

#### **Increased Noise and Vibration Levels**

The Proposed Action has the potential to generate noise and vibrations during construction and operation of various equipment used for deployment. These noise and vibration levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise and vibrations could cause impacts on residential areas, or other facilities that are sensitive to noise and vibrations, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 6.1.13, Noise).

Based on the significance criteria presented in Table 6.2.13-1, noise and vibration impacts would likely be *less than significant* at the programmatic level, given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise and vibration sources be deployed/operated long-term in the same area. Noise and vibration levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise and vibration effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise- and vibration-sensitive receptors. However, given that much of the construction and operation of the Proposed Action would often occur in populated areas, FirstNet may not be able to completely avoid noise or vibration impacts.

**Table 6.2.13-1: Impact Significance Rating Criteria for Noise and Vibration at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased noise and vibration levels	Magnitude or Intensity	Noise and vibration levels would exceed typical noise and vibration 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 exceed 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 <i>potentially significant, but with mitigation is less than significant.</i>	Noise and vibration levels resulting from project activities would exceed natural sounds, but would not exceed typical noise and vibration levels from construction equipment or generators.	Natural sounds would prevail. Noise and vibration generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

dBA = A-weighted decibel(s); VdB = vibration decibel(s)

#### **6.2.13.4. 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 and vibration impacts and while others would not. In addition, the same type of Proposed Action Infrastructure could result, at the programmatic level, in a range of *no impacts to less than significant impacts* depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise or vibration impacts under the conditions described below:

- **Wired Projects**
  - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibrations 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 or installation activities, and therefore would have no noise or vibration impacts.
- **Satellites and Other Technologies**
  - **Satellite Enabled Devices and Equipment:** The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise and vibrations would be emitted during installment of this equipment. Noise and vibrations 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 noise and vibration sensitive resources at the programmatic level.
  - **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 or vibration-sensitive resources, it is anticipated that this activity would have *no impact* on those resources at the programmatic level.

*Activities with the Potential for Impacts at the Programmatic Level*

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to 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 and vibration levels from the use of heavy equipment and machinery.
  - **New Build – Aerial Fiber Optic Plant:** The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise and vibration levels from the use of vehicles and machinery.
  - **Collocation on Existing Aerial Fiber Optic Plant:** Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise and vibration levels from the use of heavy equipment and machinery.
  - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise and vibration levels if the activity required the use of heavy equipment for grading or other purposes.
  - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited nearshore and inland bodies of water could generate noise and vibration if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable could result in short-term and temporarily increased noise and vibration levels to local residents and other noise and vibration-sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - **Installation of Optical Transmission or Centralized Transmission Equipment:** Noise and vibrations 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 and vibration impacts would not occur. Heavy equipment used to grade and construct access roads could generate increased levels of noise and vibrations over baseline levels temporarily.

- **Wireless Projects**
  - **New Wireless Communication Towers:** Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise and vibrations. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise and vibration levels.
  - **Collocation on Existing Wireless Tower, Structure, or Building:** Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact local noise sensitive resources temporarily. Vibration impacts are expected to be negligible.
  - **Deployable Technologies:** The type of deployable technology used would dictate the types of noise and vibrations generated. For example, mobile equipment deployed via heavy trucks could generate noise and vibrations from the internal combustion engines associated with the vehicles and onboard generators. Aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise and vibrations during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact the local noise and vibration- sensitive resources.

In general, noise and vibrations from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be *less than significant* at the programmatic level, due to the temporary duration of deployment activities. Additionally, pre-existing noise and vibration levels would be achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

Operation activities associated with the Preferred Alternative would be *less than significant* at the programmatic level and similar to several of the deployment activities related to routine maintenance and inspection of the facilities because of the temporary nature of the activities, which would not create new permanent sources of noise or vibrations. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise and vibration impacts could result as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.13.5. Alternatives Impact Assessment**

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

#### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise and vibration impacts are as follows:

#### *Deployment Impacts*

Implementing deployable technologies could result in noise and vibrations from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise and vibration levels. Several vehicles traveling together could also create short-term noise and vibration impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise and vibrations during all phases of flight. Aerial technologies would have the highest level of noise and vibration impact if they are required to fly above residential areas, areas with a high concentration of noise-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, at the programmatic level, 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. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operation Impacts*

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise and vibrations in the area.

However, deployable technologies could be deployed to areas with few existing facilities, so noise and vibration impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise and vibration impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. At the programmatic level, this could generate *less than significant*, short-term impacts on any residential areas or other noise and vibration -sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient noise. By not deploying NPSBN, FirstNet would avoid generating noise or vibrations from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies. Noise and vibrations would therefore be the same as described in Section 6.1.9, Noise and Vibrations.

## **6.2.14. Climate Change**

### **6.2.14.1. Introduction**

This section describes potential impacts to climate and climate change-vulnerable resources in Georgia associated with deployment and operation of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.14.2. 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 6.2.14-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or alternatives (CEQ, 2016).

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, 2016). 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 6.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	See discussion below in Section 6.2.14.5, Potential Impacts of the Preferred Alternative	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent			Global impacts observed.	NA
	Duration or Frequency			Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is <i>potentially significant</i> , but with mitigation is <i>less than significant</i> .	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

### 6.2.14.3. Projected Future Climate

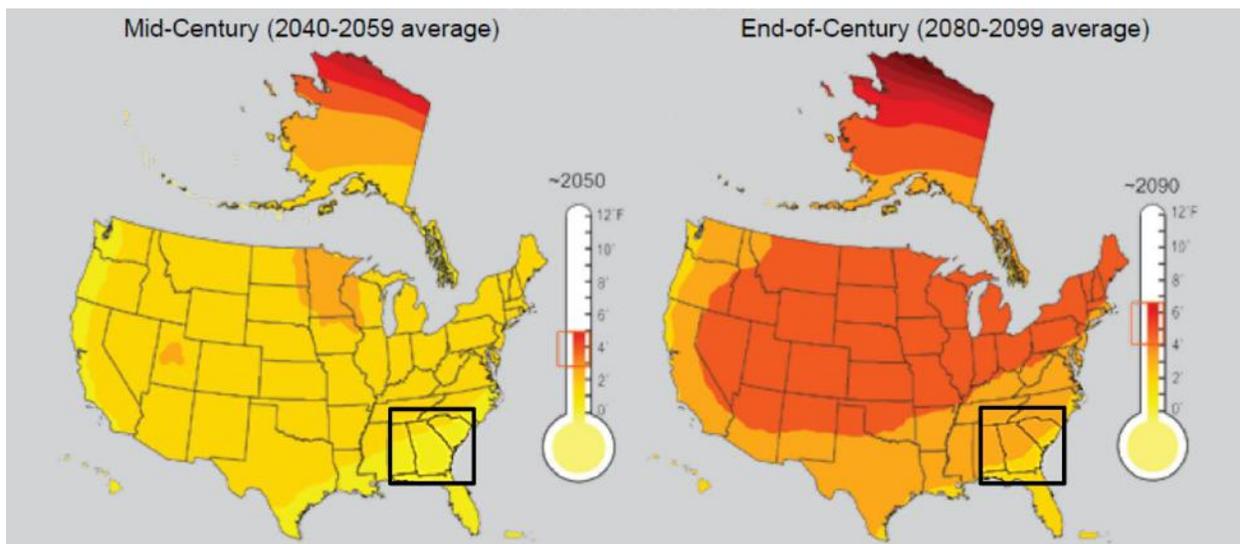
Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. Since 1970, Georgia has experienced an increasing numbers of days above 95°F and nights above 75°F, with a decrease in the numbers of extremely cold days. Temperatures across this section of the U.S. are expected to increase during this century. Major consequences of warming include significant increases in the number of hot days, defined as 95°F or above, and decreases in freezing events. (USGS, 2015o)

#### Air Temperature

Figure 6.2.14-1 and Figure 6.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Georgia from a 1969 to 1971 baseline.

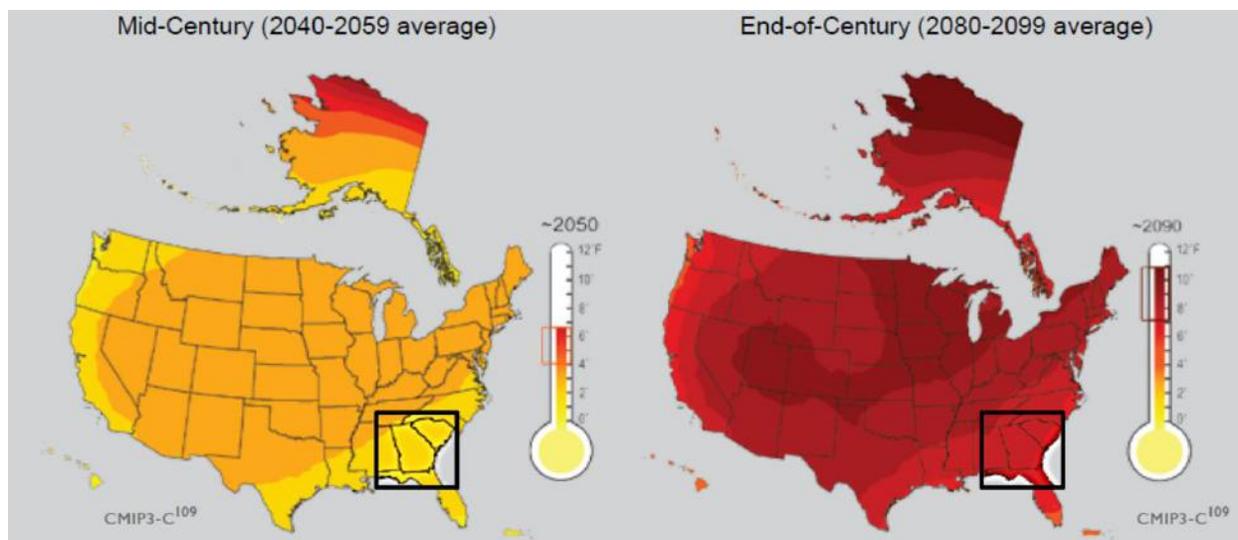
Cfa – Figure 6.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the northern portion of Georgia under a low emissions scenario would increase by approximately 4°F, and in the southern portion temperatures are expected to increase by approximately 3°F. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in the northern portion of Georgia would increase by approximately 5°F, and in the southern portion of the state temperatures are expected to increase by approximately 4°F. (USGCRP, 2009)

Figure 6.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 4°F in the entire state of Georgia. Under a high emissions scenario for the period (2080 to 2099) in Georgia, temperatures would increase by approximately 8°F in the majority of the state while around the southern coast temperatures are expected to increase by 7°F. (USGCRP, 2009)



Source: (USGCRP, 2009)

**Figure 6.2.14-1: Georgia Low Emission Scenario Projected Temperature Change**



Source: (USGCRP, 2009)

**Figure 6.2.14-2: Georgia High Emission Scenario Projected Temperature Change**

### Precipitation

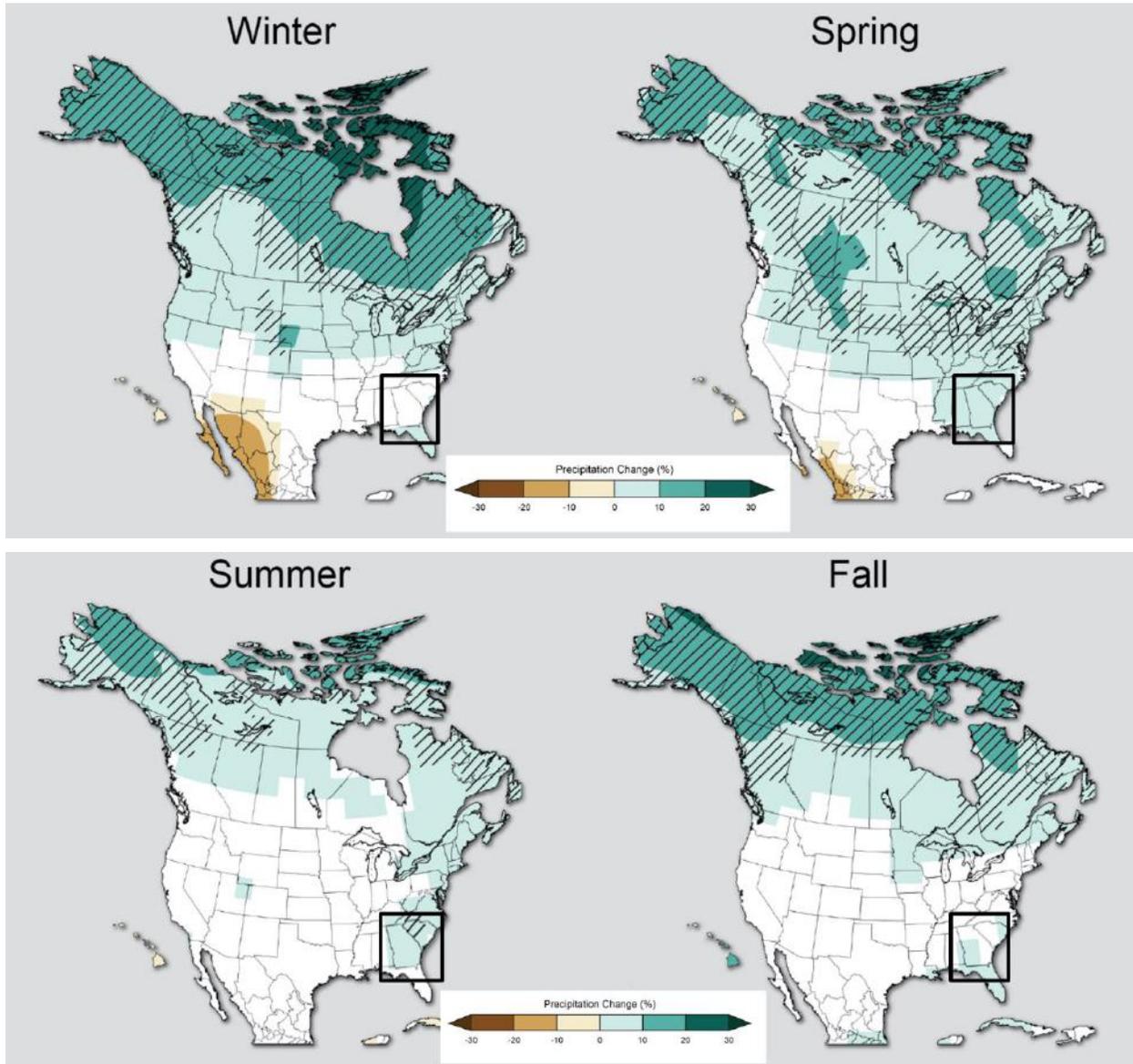
Future precipitation projections in the Southeast are much less certain than projections for temperature. The Southeast is located in the transition zone between projected wetter conditions to the north and drier conditions to the southwest; therefore, many of the model projections show only small changes relative to natural variations. However, many models do project drier conditions in the far southwest portion of the region and wetter conditions in the far northeast portion of the region. (USGCRP, 2009)

Figure 6.2.14-3 and Figure 6.2.14-4 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 6.2.14-3 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, 2014a)

Figure 6.2.14-4 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, 2014a)

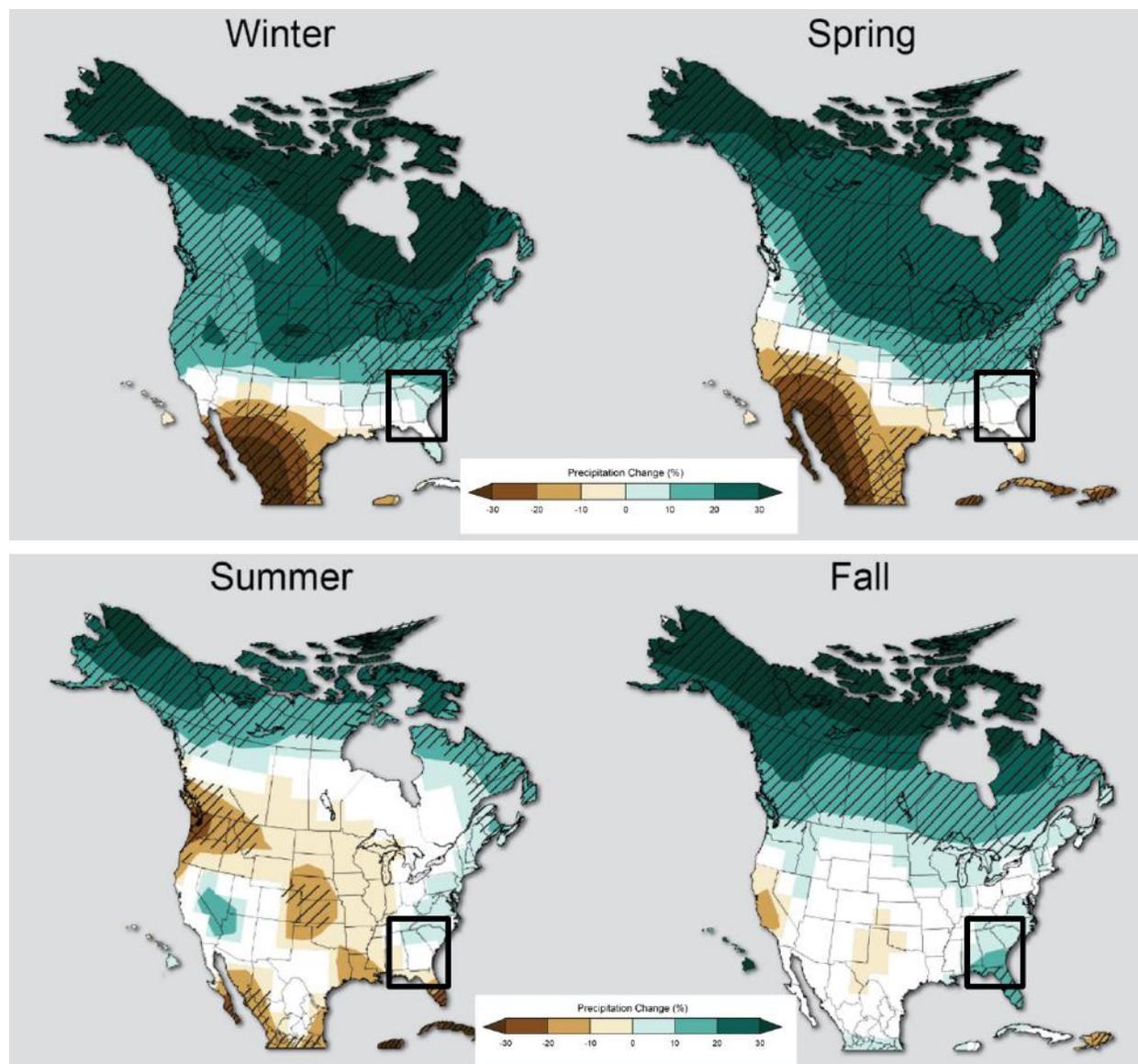
Cfa - Figure 6.2.14-3 shows that in a low emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in spring and summer for the entire state of Georgia. However, there are no expected increases in precipitation in winter other than fluctuations due to natural variability. In fall, precipitation is expected to increase by 10 percent on the west side of the state while some portions of the state are not expected to have any changes in precipitation. (USGCRP, 2014a)

Figure 6.2.14-4 shows that if emissions continue to increase, winter, spring, and summer precipitation could increase up to 10 percent in some areas of the state while other portions of the state are not expected to have any changes in precipitation over the period 2071 to 2099. In fall, precipitation in this scenario could increase as much as 20 percent in the southern portion of the state and 10 percent in the rest of the state. (USGCRP, 2014a)



Source: (USGCRP, 2014a)

**Figure 6.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario**



Source: (USGCRP, 2014a)

**Figure 6.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario**

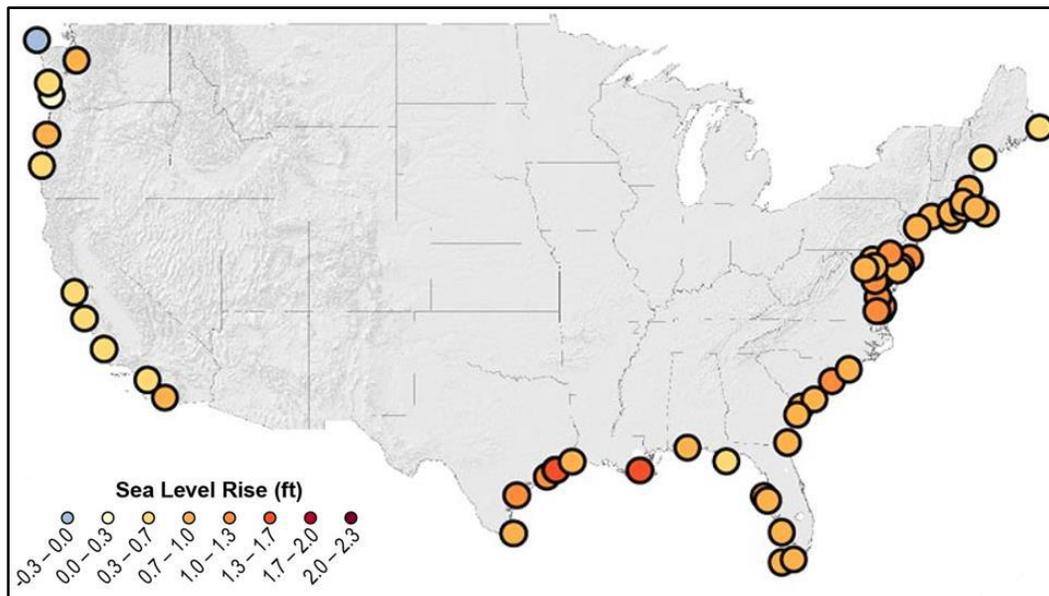
### Sea Level

Several factors would continue to affect sea level rise in the future. Glacier melt adds water to the ocean, and increasing ocean temperatures result in thermal expansion. Worldwide, “glaciers have generally shrunk since the 1960s, and the rate at which glaciers are melting has accelerated over the last decade. The loss of ice from glaciers has contributed to the observed rise in sea level.” When water warms, it also expands, which contributes to sea level rise in the world’s oceans. “Several studies have shown that the amount of heat stored in the ocean has increased substantially since the 1950s.” Sea level and currents could be influenced by the amount of heat stored in the ocean.

The amount of sea level rise would vary in the future along different stretches of the U.S. coastline and under different absolute global sea level rise scenarios. Variation in sea level rise along different stretches of coast is mostly due to varying rates of land subsidence (also known as relative sea level rise). The National Climate Assessment (NCA) reports potential sea level rise scenarios. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA, 2012b).

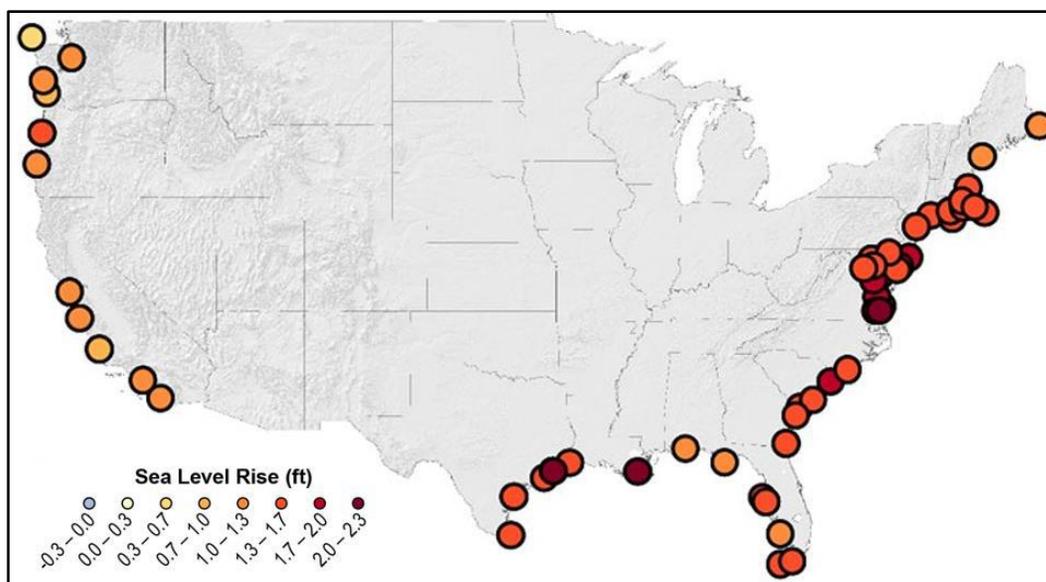
Figure 6.2.14-5 and Figure 6.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 6.2.14-5 shows an 8-inch global sea level rise above 1992 levels by 2050 and Figure 6.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014b).

Cfa – Figure 6.2.14-5 presents an 8-inch global average sea level rise above 1992 levels, resulting in a 0.7 to 1 foot sea level rise in 2050 along the coast of Georgia. Figure 6.2.14-6 indicates that a 1.24-foot sea level rise above 1992 levels would result in a 1.3 to 1.7 foot sea level rise in 2050 along the coast of Georgia. (USGCRP, 2014b)



Source: (USGCRP, 2014b)

**Figure 6.2.14-5: An 8-Inch Sea Level Rise Above 1992 Levels by 2050**



Source: (USGCRP, 2014b)

**Figure 6.2.14-6: A 1.24-Foot Sea Level Rise Above 1992 Levels by 2050**

### 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)

U.S. 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 to 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 provide greater certainty (Rochester Academy of Science, 2015).

#### **6.2.14.4. 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<sub>2</sub> emissions from fossil fuels.

Based on the impact significance criteria presented in Table 6.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

##### **Climate Change**

Climate change may increase project-related 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. These impacts will be considered fully in Chapter 18, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

Forested areas of the Southeast, including Georgia, may be at a higher risk of wildland fires, particularly during the periods of extended drought that are forecasted under warming scenarios (Mitchell, 2014).

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.

The entire state of Georgia is at risk for stronger hurricanes as a result of climate change. Sea level rise would increase the height, areal extent, and persistence of coastal flooding during these events (USGCRP, 2014d). Stronger storms may also increase the potential for damage from high winds and wind-borne debris. In inland areas of Georgia out of the immediate path of storm surge are nevertheless at risk of 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, 2014e).

Urban areas in particular will be at risk of increased intensity and duration of heat waves, particularly in the metropolitan Atlanta region (Yan Zhou, 2009), although overall the increase in heat waves is projected to be less in the south than for other regions of the U.S. (USGCRP, 2014e). Extended periods of extreme heat may impede the operation of and increase electricity demand on the grid in the Southeastern states (DOE, 2015), and overwhelm the capacity of onsite equipment needed to keep microwave and other transmitters cool.

Based on the impact significance criteria presented in Table 6.2.14-1, climate change effects on FirstNet installations and infrastructure would be *potentially significant* if they negatively affected the operation of these facilities.

#### ***6.2.14.5. Potential Impacts of the Preferred Alternative***

##### **Greenhouse Gas Emissions**

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred in Georgia, including deployment and operation activities.

As described in Section 2.1.2, 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, at the programmatic level, in a range of *no impacts to less than significant impacts with BMPs and mitigation measures incorporated* depending on the deployment scenario or site-specific conditions.

##### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to climate change under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.

Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.

- Satellites and Other Technologies
  - Distribution of Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

*Activities with the Potential to Have Impacts at the Programmatic Level*

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration, and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wired Projects
  - New Build - Buried Fiber Optic Plant: This activity would include plowing (including vibratory plowing), trenching, and directional boring, and could involve construction of POPs, huts, or other facilities to house outside plant equipment or hand holes to access fiber. These activities could generate GHG emissions.
  - New Build Aerial Fiber Optic Plant: These projects would require construction equipment for installing or replacing new poles and hanging cables as well as excavation and grading for new or modified right-of-ways or easements. It could also include construction of POPs, huts, or other facilities to house outside plant equipment. These activities could generate GHG emissions.
  - Collocation on Existing Aerial Fiber Optic Plant: These projects would require equipment for replacement of existing wiring and poles. GHG emissions associated with these projects would arise from use of machinery and vehicles to complete these activities.
  - New Build – Submarine Fiber Optic Plant: The deployment of small work boats with engines similar to recreational vehicle engines may be required to transport and lay small wired cable. The emissions from these small marine sources would contribute to GHGs.
  - Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.
- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical

- feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction, as it would not occur. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
  - Deployable Technologies
    - COWs, COLTs, SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts if operated in large numbers over the long-term. However, this would be highly dependent on their size, number, and the frequency and duration of their use.
    - Emissions associated with the deployment and maintenance of a complete network solution of this type may be 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. These emissions would arise from the combustion of fuel used by equipment during construction and operation. The total potential level of GHG emissions would be *less than significant at the programmatic level*; although geographically large (all 50 states and five territories, and the District of Columbia) any one site would be limited in extent and emit minor levels of GHG emissions as explained in the analysis. Land use related emissions occurring as a result of soil disturbance and loss of vegetation are expected to be *less than significant* at the programmatic level, due to the limited and localized nature of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Climate Change Impacts on FirstNet Infrastructure or Operations**

At the programmatic level, climate change effects on the Preferred Alternative could be *potentially significant to less than significant with BMPs and mitigation measures incorporated* because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or

there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating *adverse effects* of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

#### ***6.2.14.6. Alternatives Impact Assessment***

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

#### **Deployable Technologies Alternative**

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

#### *Deployment Impacts*

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be *less than significant* at the programmatic level, based on the defined significance criteria, since activities would be temporary and short-term. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Operations Impacts*

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have a *less than significant* impact, multiple vehicles operating for longer periods, in close proximity, may

have a cumulative impact, although this impact is expected to be *less than significant* at the programmatic level due to the temporary nature of the operation of deployables. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be *less than significant* at the programmatic level due to the limited duration of deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration.

### **Climate Change Impacts on FirstNet Deployable Infrastructure or Operations**

Climate change effects have the most noticeable impacts over a long period. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to *no impact* at the programmatic level on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be *no impacts* to GHG emissions or climate as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.14, Climate Change.

## **6.2.15. Human Health and Safety**

### **6.2.15.1. Introduction**

This section describes potential impacts to human health and safety in Georgia associated with deployment of the Proposed Action and Alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **6.2.15.2. 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 6.2.15-1. As described in Section 6.2, Environmental Consequences, the categories of impacts are defined, at the programmatic level, as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.

### **6.2.15.3. 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 6.2.15-1, occupational injury impacts could be *potentially significant* if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical or chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

To protect occupational workers, the OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2016e).

1. Engineering controls;
2. Work practice controls;
3. Administrative controls; and then
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,<sup>172</sup> chain locks, bollards, storage containers (for storing equipment and chemicals), or signage and caution tape. Other forms of engineering controls could include machinery designed to manipulate the quality of the work environment, such as ventilation blowers. Whenever practical, engineering controls may result in the complete removal of the hazard from the work site, an example of which would be the transport and offsite disposal of hazardous waste or asbestos containing materials.

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 2016e). 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 (SOPs) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2016e). 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.

GADOL is not authorized by OSHA to administer a state program for public or private sector employers. Therefore, GADOL defers all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

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<sup>172</sup> Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016d)

**Table 6.2.15-1: Impact Significance Rating Criteria for Human Health and Safety at the Programmatic Level**

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level locations and , as opposed to throughout the state or territory..	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level locations and , as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Manmade Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the 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 <i>potentially significant</i> , but with mitigation is <i>less than significant</i> at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level locations and , as opposed to throughout the state or territory..	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

## **Hazardous Materials, Hazardous Waste, and Mine Lands**

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions because of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 6.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the Georgia Department of Environmental Protection (GADEP), 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, and applicable Georgia 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 GADEP may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRA's help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRA's take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

## Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 6.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. At the programmatic level, 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. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### ***6.2.15.4. 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, at the programmatic level, in a range of *no impacts to less than significant with mitigation measures incorporated*, depending on the deployment scenario or site-specific activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### *Activities Likely to Have No Impacts at the Programmatic Level*

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* at the programmatic level 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 could be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be *no impacts* at the programmatic level to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* to human health and safety at the programmatic level because there would be no ground disturbance or heavy equipment used.
- **Satellites and Other Technologies**
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have *no impact* at the programmatic level on those resources.

#### *Activities with the Potential to Have Impacts at the Programmatic Level*

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety at the programmatic level 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, vibrations, 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 bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water, exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general

public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of RF 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 and vibrations 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, noise, and vibrations. 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 RF 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 potentially harmful environments (road ROWs, work over water, environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise and vibration exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level, due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### **Operation Impacts**

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. At the programmatic level, it is anticipated that there would be *less than significant* impacts to human health and

safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment 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 and vibration exposure, and risk of infectious disease transmission would be *less than significant* at the programmatic level, due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

#### **6.2.15.5. 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, at the programmatic level, 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 were an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in *less than significant* impacts to human health and safety at the programmatic level. 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 and vibration exposure, and risk of infectious

disease transmission would be *less than significant* at the programmatic level due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

### *Operation Impacts*

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to human health and safety associated with routine inspections of the Preferred Alternative. Use of 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* at the programmatic level, because of the small scale of likely FirstNet activities; activities associated with routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

### **No Action Alternative**

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* at the programmatic level to human health and safety as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 6.1.15, Human Health and Safety.

## GA APPENDIX A – BIOLOGICAL RESOURCES

**Table A-1: GADNR S1 Ranked Terrestrial Communities of Concern in Georgia**

Vegetative Community Type	USEPA Ecoregion(s)	Description	Distribution
South Atlantic Coastal Shell Midden Woodland	Southern Coastal Plain	Shrub dominated community found on coastal sands, American Indian shell middens, <sup>a</sup> and natural shell deposits in maritime landscapes. Canopy species include southern red cedar ( <i>Juniperus virginiana</i> var. <i>silicicola</i> ), cabbage palm ( <i>Sabal palmetto</i> ), and oak. The shrub layer is dense.	FL, GA, NC, SC.
South Atlantic Mixed Oak-Pine Calcareous Flatwoods Forest	Southern Coastal Plain	Wet flatwoods occurs in seasonally flooded, flat or gently sloping environments; the canopy dominated by oak and pine species. Shrubs such as hawthorn ( <i>Crataegus</i> spp.) and wax myrtle ( <i>Morella cerifera</i> ) may be major components. Herbaceous layer is dense.	Restricted to southeast coastal GA where it has been documented between Satilla and St. Mary's River. May occur in north FL.
Blackland Prairie	Southeastern Plains	Small, open grasslands with clayey soils, surrounded by hardwood and pine forests. Vegetative community consists of showy wildflowers (for example, gray-headed coneflower [ <i>Ratibida pinnata</i> ], starry rosinweed [ <i>Silphium asteriscus</i> ]) and prairie grasses (for example: Indian grass [ <i>Sorghastrum</i> spp.], and big bluestem [ <i>Andropogon gerardi</i> ]).	Houston, Peach, Twiggs, and Bleckley Counties of GA.
Southern Ridge and Valley Sub-Calcareous Shale Barren	Ridge and Valley	Community is primarily open shrubland with stunted trees or patches of grassland occurring on dry, steep slopes of weathered shale in the Red Mountain formation of northern Georgia. Typical elevation ranges from 1,200 to 1,400 feet. Dominant tree species may include dwarf chestnut oak ( <i>Quercus prinus</i> ) and pignut hickory ( <i>Carya glabra</i> ).	Northern GA. May also occur in AL.

Source: (GADNR, 2001) (GADNR, 2015d) (NatureServe, 2017)

<sup>a</sup> Indian shell middens = mounds found at human settlement sites; often containing shells, animal bones, and refuse.

**Table A-2: Essential Fish Habitat for Mid-Atlantic Species of Georgia**

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Atlantic Sharpnose Shark (highly migratory)	No EFH egg life stage.	Gulf of Mexico coastal areas from Texas through the Florida Keys. In the Atlantic from the mid-coast of Florida to Cape Hatteras.	Gulf of Mexico coastal areas from Texas through the Florida Keys. In the Atlantic from the mid-coast of Florida to Cape Hatteras, and a localized area off of Delaware.	Gulf of Mexico from Texas through the Florida Keys out to a depth of 200 meters. In the Atlantic from the mid-coast of Florida to Maryland.
Bigeye Thresher Shark (highly migratory)	No EFH egg life stage.	Offshore along the central Gulf of Mexico and off Key West, Florida. Offshore along the Atlantic east coast from southern to the mid-Florida coast, and from Georgia to southern New England.	Offshore along the central Gulf of Mexico and off Key West, Florida. Offshore along the Atlantic east coast from southern to the mid-Florida coast, and from Georgia to southern New England.	Offshore along the central Gulf of Mexico and off Key West, Florida. Offshore along the Atlantic east coast from southern to the mid-Florida coast, and from Georgia to southern New England.
Bigeye Tuna (highly migratory)	No EFH defined.	No EFH defined.	Offshore in the Gulf of Mexico south of Louisiana and Mississippi, off the southern west coast of Florida, and south of the Florida Keys; as well as in the Atlantic off the Florida east coast through South Carolina, and from North Carolina, south of Cape Hatteras, to Cape Cod.	Offshore in the central Gulf of Mexico and the mid-east coast of Florida. Atlantic east coast from Cape Hatteras to Cape Cod.
Bignose Shark (highly migratory)	No EFH egg life stage.	No EFH defined.	Localized offshore areas from Louisiana through the west coast Florida to the Florida Keys in the Gulf of Mexico, and the east coast of Florida and South Carolina in the Atlantic. Continuous offshore EFH from North Carolina to New Jersey.	Localized offshore areas from Louisiana through the west coast Florida to the Florida Keys in the Gulf of Mexico, and the east coast of Florida and South Carolina in the Atlantic. Continuous offshore EFH from North Carolina to New Jersey.
Blacknose Shark (highly migratory)	No EFH egg life stage.	In the Gulf of Mexico coastal areas from the Florida Panhandle and west coast of Florida. In Atlantic coastal areas from Georgia to southern North Carolina.	Localized areas off Texas and western Louisiana, and coastal areas from Mississippi through the Florida Keys in the Gulf of Mexico. Atlantic east coast from the mid-coast of Florida to Cape Hatteras.	Localized areas off Texas and central Louisiana, and coastal areas from eastern Louisiana through the Florida Keys in the Gulf of Mexico. Atlantic east coast from the mid-coast of Florida to Cape Hatteras.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Blacktip Shark (highly migratory)	No EFH egg life stage.	Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas from northern Florida through Georgia, and the mid-coast of South Carolina.	Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas localized off of the southeast Florida coast and from West Palm Beach, Florida to Cape Hatteras.	Coastal areas in the Gulf of Mexico from Texas through the Florida Keys. In Atlantic coastal areas southeast Florida to Cape Hatteras.
Bluefish	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream), at mid-shelf depths.	Offshore, the pelagic waters greater than 45 feet over the Continental Shelf, and the “slope sea” and Gulf Stream between latitudes 29° 00 N and 40° 00 N.	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream), and the “slope sea” and Gulf Stream between latitudes 29 00 N and 40 00 N. Inshore, EFH includes all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida.	Offshore, the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream). Inshore, EFH includes all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida.
Atlantic butterfish	No EFH south of North Carolina.	No EFH south of North Carolina.	On the outer continental shelf from southern New England to South Carolina.	On the inner and outer continental shelf from southern New England to South Carolina.
Blue Marlin (highly migratory)	No EFH in Georgia.	No EFH in Georgia.	In the central Gulf of Mexico from southern Texas to the Florida Panhandle through the Florida Keys to southern Cape Cod.	In the central Gulf of Mexico, from southern Texas to the Florida Panhandle, through the Florida Keys to southern Cape Cod.
Blue Shark (highly migratory)	No EFH egg life stage.	No EFH in Georgia.	No EFH in Georgia.	Localized areas in the Atlantic off Florida and Georgia, and from South Carolina to the Gulf of Maine.
Bonnethead Shark (highly migratory)	No EFH egg life stage.	Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the midcoast of Florida to South Carolina.	Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the midcoast of Florida to South Carolina.	Coastal areas in the Gulf of Mexico along Texas, and from eastern Mississippi through the Florida Keys. Atlantic east coast from the mid-coast of Florida to Cape Lookout.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Bull Shark (highly Migratory)	No EFH egg life stage.	No EFH designated in Georgia.	Gulf of Mexico coastal areas along the Texas coast, eastern Louisiana to the Florida Panhandle, and the west coast of Florida through the Florida Keys. Atlantic coastal areas localized from the mid-east coast of Florida to South Carolina.	Gulf of Mexico along the southern and mid-coast of Texas to western Louisiana, eastern Louisiana to the Florida Keys. East coast of Florida to South Carolina in the Atlantic.
Common Thresher Shark (highly migratory)	No EFH egg life stage.	Localized areas in the central Gulf of Mexico and Florida Keys. In the Atlantic, localized areas off the mid-east coast of Florida, Georgia, South Carolina, and the Gulf of Maine, and from North Carolina through Cape Cod.	Localized areas in the central Gulf of Mexico and Florida Keys. In the Atlantic, localized areas off the mid-east coast of Florida, Georgia, South Carolina, and the Gulf of Maine, and from North Carolina through Cape Cod.	Localized areas in the central Gulf of Mexico and Florida Keys. In the Atlantic, localized areas off the mid-east coast of Florida, Georgia, South Carolina, and the Gulf of Maine, and from North Carolina through Cape Cod.
Dusky Shark (highly migratory)	No EFH egg life stage.	Areas along the Atlantic east coast of Florida to the mid-coast of Georgia, South Carolina to southern Cape Cod.	Localized areas in the central Gulf of Mexico, southern Texas, the Florida Panhandle, mid-west coast of Florida, and Florida Keys. Atlantic east coast of Florida, and South Carolina to southern Cape Cod.	Localized areas in the central Gulf of Mexico, southern Texas, the Florida Panhandle, mid-west coast of Florida, and Florida Keys. Atlantic east coast of Florida, and South Carolina to southern Cape Cod.
Finetooth Shark (highly migratory)	No EFH egg life stage.	Along the Gulf of Mexico coast of Texas, eastern Louisiana, Mississippi, Alabama, and the Florida Panhandle. Atlantic east coast along Georgia and South Carolina.	Localized coastal areas along southern Texas and Key West, Florida, and from eastern Louisiana through the Florida Panhandle in the Gulf of Mexico. Atlantic east coast from the mid-coast of Florida to Cape Hatteras.	Localized coastal areas along southern Texas and Key West, Florida, and from eastern Louisiana through the Florida Panhandle in the Gulf of Mexico. Atlantic east coast from the mid-coast of Florida to Cape Hatteras.
Great Hammerhead Shark (highly migratory)	No EFH egg life stage.	Coastal areas throughout the west coast of Florida and scattered in the Gulf of Mexico from Alabama to Texas. Atlantic east coast from the Florida Keys to New Jersey.	Coastal areas throughout the west coast of Florida and scattered in the Gulf of Mexico from Alabama to Texas. Atlantic east coast from the Florida Keys to New Jersey.	Coastal areas throughout the west coast of Florida and scattered in the Gulf of Mexico from Alabama to Texas. Atlantic east coast from the Florida Keys to New Jersey.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Lemon Shark (highly migratory)	No EFH egg life stage.	No EFH defined in Georgia.	Gulf of Mexico coastal areas along Texas, eastern Louisiana, and the Florida Panhandle through the Florida Keys. Coastal areas along the Atlantic east coast of Florida. Includes a small area along the southeast Georgia coast.	Gulf of Mexico coastal areas along the west coast of Florida through the Florida Keys. Localized coastal areas along the southern and northern east coast of Florida in the Atlantic. Includes a small area along the southeast Georgia coast.
Longbill Spearfish (highly migratory).	No EFH designated.	No EFH designated.	In the central Gulf of Mexico through eastern Louisiana to the Florida Panhandle. In the Atlantic from Florida Keys to the mid-east coast of Florida and localized areas from northern Florida to Cape Cod, with concentrations from North Carolina to Delaware.	Same as juvenile EFH.
Longfin Mako Shark (highly migratory)	No EFH egg life stage.	Offshore central Gulf of Mexico through the Florida Keys. In the Atlantic from southern Florida through South Carolina, off North Carolina, and Cape Hatteras to Cape Cod.	Offshore central Gulf of Mexico through the Florida Keys. In the Atlantic from southern Florida through South Carolina, off North Carolina, and Cape Hatteras to Cape Cod.	Offshore central Gulf of Mexico through the Florida Keys. In the Atlantic from southern Florida through South Carolina, off North Carolina, and Cape Hatteras to Cape Cod.
Night Shark (highly migratory)	No EFH egg life stage.	Offshore in the Gulf of Mexico off Texas, Louisiana, and the Florida Panhandle to the Florida Keys. Southern and mid-east coast of Florida and South Carolina to Delaware in the Atlantic.	Offshore in the Gulf of Mexico off Texas, Louisiana, and the Florida Panhandle to the Florida Keys. Southern and mid-east coast of Florida and South Carolina to Delaware in the Atlantic.	Offshore in the Gulf of Mexico off Texas, Louisiana, and the Florida Panhandle to the Florida Keys. Southern and mid-east coast of Florida and South Carolina to Delaware in the Atlantic.
Nurse Shark (highly migratory)	No EFH egg life stage.	No EFH designated.	Coastal areas in the Gulf of Mexico from the Florida Panhandle to the Florida Keys. Atlantic east coast of Florida to southern Georgia.	No EFH designated in Georgia.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Oceanic Whitetip Shark (highly migratory)	No EFH egg life stage.	Offshore at localized areas in the central Gulf of Mexico and Florida Keys. Offshore in the Atlantic in depths greater than 200 meters from Florida to southern New England.	Offshore at localized areas in the central Gulf of Mexico and Florida Keys. Offshore in the Atlantic in depths greater than 200 meters from Florida to southern New England.	Offshore at localized areas in the central Gulf of Mexico and Florida Keys. Offshore in the Atlantic in depths greater than 200 meters from Florida to southern New England.
Roundscale Spearfish (highly migratory, similar to white marlin)	No EFH designated.	No EFH designated.	Offshore in the central Gulf of Mexico from southern Texas to the Florida Panhandle. Florida Keys to mid-east coast of Florida, and Georgia to Cape Cod.	Offshore in the central Gulf of Mexico from southern Texas to the Florida Panhandle. Florida Keys to the mid-east coast of Florida, and South Carolina to Cape Cod.
Sailfish (highly migratory)	No EFH defined for Georgia.	No EFH defined for Georgia.	In the central Gulf of Mexico, and off southern Texas, Louisiana, and the Florida Panhandle. Atlantic east coast from the Florida Keys to mid-coast of South Carolina, the Outer Banks of North Carolina and Maryland.	In the central Gulf of Mexico, and off southern Texas, Louisiana, and the Florida Panhandle. Atlantic east coast from the Florida Keys to mid-coast of South Carolina, the Outer Banks of North Carolina and Maryland.
Sand Tiger Shark (highly migratory)	No EFH egg life stage.	Along the Atlantic east coast from northern Florida to Cape Cod.	No EFH defined in Georgia.	Localized areas along the mid and northern east coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New Jersey in the Atlantic.
Sandbar Shark (highly migratory)	No EFH egg life stage.	Localized coastal area on the Florida Panhandle. Atlantic coastal areas localized along Georgia and South Carolina, and from Cape Lookout to Long Island, New York.	Localized areas along the Atlantic coast of Florida, South Carolina, and southern North Carolina, and from Cape Lookout to southern New England.	Localized area off of Alabama, and coastal areas from the Florida Panhandle to the Florida Keys in the Gulf of Mexico. Atlantic coastal areas throughout Florida to southern New England.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Scalloped Hammerhead Shark (highly migratory)	No EFH egg life stage.	Coastal areas in the Gulf of Mexico from Texas to the southern west coast of Florida. Atlantic east coast from the mid-east coast of Florida to southern North Carolina.	Coastal areas in the Gulf of Mexico from the southern to mid-coast of Texas, eastern Louisiana to the southern west coast of Florida, and the Florida Keys. Offshore from the mid-coast of Texas to eastern Louisiana. Atlantic east coast of Florida through New Jersey.	Coastal areas in the Gulf of Mexico along the southern Texas coast, and eastern Louisiana through the Florida Keys. Offshore from southern Texas to eastern Louisiana.
Silky Shark (highly migratory)	No EFH egg life stage.	In the Gulf of Mexico from the southern coast of Texas across the central Gulf of Mexico, and from eastern Louisiana to the Florida Keys. Atlantic east coast from Florida to New Jersey, with localized areas in southern New England.	In the Gulf of Mexico from the southern coast of Texas across the central Gulf of Mexico, and from eastern Louisiana to the Florida Keys. Atlantic east coast from Florida to New Jersey, with localized areas in southern New England.	In the Gulf of Mexico from the southern coast of Texas across the central Gulf of Mexico, and from eastern Louisiana to the Florida Keys. Atlantic east coast from Florida to New Jersey, with localized areas in southern New England.
Skipjack Tuna (highly migratory)	In offshore waters in the Gulf of Mexico to the EEZ and portions of the Florida Straits (no EFH in Georgia).	In offshore waters in the Gulf of Mexico to the EEZ and portions of the Florida Straits (no EFH in Georgia).	Localized areas in the central Gulf of Mexico from Louisiana through the Florida Panhandle. Localized areas in the Atlantic off of Georgia, South Carolina, and North Carolina to Maryland, and from Delaware to Cape Cod and the southern east coast of Florida through the Florida Keys.	No EFH in Georgia.
Spinner shark (highly migratory)	No EFH egg life stage.	Localized coastal areas in the Gulf of Mexico along Texas, eastern Louisiana, the Florida Panhandle, Florida west coast, and the Florida Keys; and in the Atlantic along the east coast of Florida to southern North Carolina.	Gulf of Mexico coastal areas from Texas to the Florida Panhandle, and the mid-west coast of Florida to the Florida Keys. Atlantic east coast of Florida through North Carolina.	Localized areas in the Gulf of Mexico off of southern Texas, Louisiana through the Florida Panhandle, and from the mid-coast of Florida through the Florida Keys. In the Atlantic along the east coast of Florida, and localized areas from South Carolina to Virginia.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Summer flounder	EFH is the waters over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral, Florida, to depths of 360 feet.	EFH is the nearshore waters of the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral Florida, in nearshore waters (out to 50 miles from shore). Inshore, EFH is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the Estuarine Living Marine Resources (ELMR) database, in the “mixing” (defined in ELMR as 0.5 to 25.0 ppt) and “seawater” (defined in ELMR as greater than 25 ppt) salinity zones.	EFH is the waters over the Continental Shelf (from the coast out to the limits of the EEZ) to depths of 500 ft., from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Inshore, EFH is all of the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the “mixing” and “seawater” salinity zones.	EFH is the waters over the Continental Shelf (from the coast out to the limits of the EEZ) to depths of 500 ft., from Cape Hatteras, North Carolina to Cape Canaveral, Florida. Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the “mixing” and “seawater” salinity zones. Generally summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer Continental Shelf at depths of 500 ft. in colder months.
Swordfish (highly migratory)	Offshore from off Cape Hatteras, North Carolina extending south around peninsular Florida through the Gulf of Mexico to the U.S./Mexico border from the 200 m isobath to the EEZ boundary; associated with the Loop Current boundaries in the Gulf and the western edge of the Gulf Stream in the Atlantic.	Same as EFH for species eggs.	Offshore in the central Gulf of Mexico from southern Texas through the Florida Keys and Atlantic east coast from south Florida to Cape Cod.	Offshore in the central Gulf of Mexico from southern Texas to the Florida Panhandle and western Florida Keys. Atlantic east coast from southern Florida to the mid-east coast of Florida, and Georgia to Cape Cod.

<b>Mid-Atlantic Species</b>				
<b>Common Name</b>	<b>Eggs</b>	<b>Larvae/YOY<sup>a</sup></b>	<b>Juveniles</b>	<b>Adults</b>
Tiger Shark (highly migratory)	No EFH egg life stage.	Off Texas, western Louisiana, and the Florida Panhandle in the Gulf of Mexico. In the Atlantic from the mid-east coast of Florida to Virginia.	In the central Gulf of Mexico and off Texas and Louisiana, and from Mississippi through the Florida Keys. Atlantic east coast from Florida to New England.	In the Gulf of Mexico, from Texas to the west coast of Florida, and the Florida Keys. Atlantic east coast from Florida to southern New England.
White Shark (highly migratory)	No EFH egg life stage.	Along the mid- and southern west coast of Florida in the Gulf of Mexico, and along the mid- and northern east coast of Florida, South Carolina, and North Carolina in the Atlantic. Maryland to Cape Cod.	Along the mid- and southern west coast of Florida in the Gulf of Mexico, and along the mid- and northern east coast of Florida, South Carolina, and North Carolina in the Atlantic. Maryland to Cape Cod.	Along the mid- and southern west coast of Florida in the Gulf of Mexico, and along the mid- and northern east coast of Florida, South Carolina, and North Carolina in the Atlantic. Maryland to Cape Cod.
Yellowfin Tuna (highly migratory)	In offshore waters in the Gulf of Mexico to the EEZ and portions of the Florida Straits (no EFH in Georgia).	In offshore waters in the Gulf of Mexico to the EEZ and portions of the Florida Straits (no EFH in Georgia).	In the central Gulf of Mexico from Florida Panhandle to southern Texas. Mid-east coast of Florida and Georgia to Cape Cod.	In the central Gulf of Mexico from the Florida Panhandle to southern Texas. Mid-east coast of Florida and Georgia to Cape Cod.

Source: (NOAA, 2015a)

<sup>a</sup> Young of the Year (YOY): “All of the fish of a species that were born in the past year, from transformation to juvenile until January 1” (USEPA, 2015c).

**Table A-3: Essential Fish Habitat for South Atlantic Species of Georgia**

<b>South Atlantic Species</b>	
<b>Species</b>	<b>Description of EFH</b>
Coastal Migratory Pelagics	<p>EFH for coastal migratory pelagic species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward, including <i>Sargassum</i>. In addition, all coastal inlets, all state-designated nursery habitats of particular importance to coastal migratory pelagics.</p> <p>For cobia, EFH also includes high salinity bays, estuaries, and seagrass habitat. In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse coastal migratory pelagic larvae.</p> <p>For king and Spanish mackerel and cobia EFH occurs in the South Atlantic and Mid-Atlantic Bights.</p>
Corals	<p>EFH for <i>Antipatharia</i> (black corals) includes rough, hard, exposed, stable substrate, offshore in high (30-35%) salinity waters in depths exceeding 18 meters (54 feet), not restricted by light penetration on the outer shelf throughout the management area.</p> <p>EFH habitat for octocorals excepting the order Pennatulacea (sea pens and sea pansies) includes rough, hard, exposed, stable substrate in subtidal to outer shelf depths within a wide range of salinity and light penetration throughout the management area.</p> <p>EFH for Pennatulacea (sea pens and sea pansies) includes muddy, silty bottoms in subtidal to outer shelf depths within a wide range of salinity and light penetration.</p>
Golden Crab ( <i>Chaceon feneri</i> )	<p>EFH for golden crab includes the U.S. Continental Shelf from Chesapeake Bay south through the Florida Straits (and into the Gulf of Mexico). In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse golden crab larvae.</p>
Snapper-Grouper Species	<p>EFH for snapper-grouper species includes coral reefs, live/hard bottom, submerged aquatic vegetation, artificial reefs and medium to high profile outcroppings on and around the shelf break zone from shore to at least 600 feet (but to at least 2000 feet for wreckfish) where the annual water temperature range is sufficiently warm to maintain adult populations of members of this largely tropical complex. EFH includes the spawning area in the water column above the adult habitat and the additional pelagic environment, including <i>Sargassum</i>, required for larval survival and growth up to and including settlement. In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse snapper grouper larvae.</p> <p>For specific life stages of estuarine dependent and nearshore snapper-grouper species, EFH includes areas inshore of the 100-foot contour, such as attached macroalgae; submerged rooted vascular plants (seagrasses); estuarine emergent vegetated wetlands (saltmarshes, brackish marsh); tidal creeks; estuarine scrub/shrub (mangrove fringe); oyster reefs and shell banks; unconsolidated bottom (soft sediments); artificial reefs; and coral reefs and live/hard bottom.</p>
Spiny Lobster ( <i>Palinuridae</i> )	<p>EFH for spiny lobster includes nearshore shelf/oceanic waters; shallow subtidal bottom; seagrass habitat; unconsolidated bottom (soft sediments); coral and live/hard bottom habitat; sponges; algal communities (<i>Laurencia</i>); and mangrove habitat (prop roots). In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse spiny lobster larvae.</p>

<b>South Atlantic Species</b>	
<b>Species</b>	<b>Description of EFH</b>
Peneaid Shrimp <i>(Penaeidae)</i>	EFH includes inshore estuarine nursery areas, offshore marine habitats used for spawning and growth to maturity, and all interconnecting waterbodies. Inshore nursery areas include tidal freshwater (palustrine), estuarine, and marine emergent wetlands (e.g., intertidal marshes); tidal palustrine forested areas; mangroves; tidal freshwater, estuarine, and marine submerged aquatic vegetation (e.g., seagrass); and subtidal and intertidal non-vegetated flats. This applies from North Carolina through the Florida Keys.
Rock Shrimp <i>(Sicyonia brevirostris)</i>	EFH consists of offshore terrigenous and biogenic sand bottom habitats from 18 to 182 meters in depth with highest concentrations occurring between 34 and 55 meters. This applies for all areas from North Carolina through the Florida Keys. In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse rock shrimp larvae.
Royal Red Shrimp <i>(Pleoticus robustus)</i>	EFH includes the upper regions of the continental slope from 180 meters (590 feet) to about 730 meters (2,395 feet), with concentrations found at depths of between 250 meters (820 feet) and 475 meters (1,558 feet) over blue/black mud, sand, muddy sand, or white calcareous mud. In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse royal red shrimp larvae.
Dolphin/Wahoo <i>(Delphinidae)</i>	EFH for dolphin and wahoo includes the Gulf Stream, Charleston Gyre, Florida Current, and pelagic <i>Sargassum</i> .

Source: (NOAA, 2015a)

## ACRONYMS

Acronym	Definition
AAF	Army Airfield
AARC	Average Annual Rate of Change
ACF	Apalachicola-Chattahoochee-Flint
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
AFB	Air Force Base
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARB	Air Reserve Base
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ATC	Air Traffic Control
ATL	Atlanta Airport
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BTU	British Thermal Units
CAA	Clean Air Act
CCC	Civilian Conservation Corps
CDC	Centers for Disease Control and Prevention
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CGP	Construction General Permit
CH <sub>4</sub>	Methane
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CMPA	Coastal Marshlands Protection Act
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COLT	Cell On Light Truck
COW	Cell On Wheels
CRS	Community Rating System
CWA	Clean Water Act
DACA	Deployable Aerial Communications Architecture
DHHS	Department of Health and Human Services
DoD	Department of Defense
DOE	Department of Energy

Acronym	Definition
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EIA	Energy Information Agency
ELMR	Estuarine Living Marine Resources
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right to Know Act
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FLM	Federal Land Manager
FRA	Federal Railroad Administration
FSDO	Flight Standards District Offices
FSS	Flight Service Station
FTA	Federal Transit Administration
GAAAQS	Georgia Ambient Air Quality Standards
GADEP	Georgia Department of Environmental Protection
GADNR	Georgia Department of Natural Resources
GADOL	Georgia Department of Labor
GADOT	Georgia Department of Transportation
GADPH	Georgia Department of Public Health
GADPS	Georgia Department of Public Safety
GAEPD	Georgia Department of Natural Resources, Environmental Protection Division
GAEPPC	Georgia Exotic Pest Plan Council
GAP	Gap Analysis Program
GASF	Georgia Archaeological Site File
GASHPO	Georgia State Historic Preservation Office
GEMA	Georgia Emergency Management Agency
GHG	Greenhouse Gas
GIN	Georgia Interoperability Networks
GNIS	Geographic Names Information System
GPA	Georgia Ports Authority
GPC	Georgia Power Company
GPO	Government Publishing Office
GSP	Georgia State Patrol
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HASP	Health and Safety Plans
HFC	Hydrofluorocarbons
HHRA	Human Health Risk Assessment
HPD	Historic Preservation Division
HSI	Hazardous Site Inventory

<b>Acronym</b>	<b>Definition</b>
IFC	International Finance Corporation
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LMR	Land Mobile Radio
LPB	Land Protection Branch
LPG	Liquefied Petroleum Gas
LRR	Land Resource Regions
LTE	Long Term Evolution
MAREX	University of Georgia Marine Extension Service
MARTA	Metropolitan Atlanta Rapid Transit Authority
MBTA	Migratory Bird Treaty Act
MHI	Median Household Income
MHz	Megahertz
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Tons
MOA	Military Operations Areas
MSFCMA	Magnuson-Stevens Fisheries Conservation and Management Act
MSL	Mean Sea Level
MYA	Million Years Ago
NO <sub>2</sub>	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCA	National Climate Assessment
NCED	National Conservation Easement Database
NCSL	National Conference of State Legislatures
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NHS	National Historic Site
NHT	National Historic Trail
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology

Acronym	Definition
NM	Nautical Miles
NNL	National Natural Landmarks
NOTAM	Notices To Airmen
NO <sub>x</sub>	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	National 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
NWI	National Wetlands Inventory
NWS	National Weather Service
NWR	National Wildlife Refuge
OASIS	Online Analytical Statistical Information System
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PAB	Palustrine Aquatic Wetlands
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFC	Perfluorinated Chemicals
PGA	Peak Ground Acceleration
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Points
PSCR	Public Safety Communications Research
PSC	Public Service Commission
PSD	Prevention of Significant Deterioration
PUB	Palustrine Unconsolidated Bottom
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SAV	Savannah/Hilton Head International Airport
SCEC	State Climate Extremes Committee
SCIP	Statewide Communications Interoperability Plan
SDS	Safety Data Sheets

<b>Acronym</b>	<b>Definition</b>
SDWA	Safe Drinking Water Act
SEGARRN	Southeast Georgia Regional Radio Network
SF <sub>6</sub>	Sulfur Hexafluoride
SIP	State Implementation Plan
SO <sub>2</sub>	Sulfur Dioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO <sub>x</sub>	Oxides of Sulfur
SPDES	State Pollutant Discharge Elimination System
SPL	Sound Pressure Level
SUA	Special Use Airspace
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TPY	Tons Per Year
TRI	Toxics Release Inventory
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UGA	University of Georgia
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WARRS	Western Area Regional Radio System
WCS	Wetlands Classification Standard
WMA	Wildlife Management Areas
WWI	World War I
WWII	World War II

## REFERENCES

The citations in this Final PEIS reflect the most recent information on the referenced site at the time the document was written.

- 40 CFR 230.3(t). (1993, August 25). *Clean Water Act-Guidelines for Specification of Disposal Sites for Dredged or Fill Material*. Retrieved April 6, 2015, from <http://www.ecfr.gov/cgi-bin/text-idx?SID=7977290449ab243f2865159951305a77&node=40:25.0.1.3.24&rgn=div5>
- Advisory Council on Historic Preservation. (2004, August 5). *36 CFR Part 800 - Protection of Historic Properties*. Retrieved July 21, 2015, from Advisory Council on Historic Preservation: <http://www.achp.gov/regs-rev04.pdf>
- Allard, G., & Whitney, J. (1994). *Geology of the Inner Piedmont, Carolina Terrane, and Modoc Zone in Northeast Georgia*. Retrieved October 2015, from [https://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/PR-20.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/PR-20.pdf)
- Alvey, J. S. (2005). Middle Archaic Settlement Organization in the Upper Tombigbee Drainage: A View from the Uplands. *Southeastern Archaeology*, 24(2), 199-208. Retrieved October 2015, from <http://www.jstor.org/stable/40713358>
- American Trails. (2015). *National Recreation Trails Database*. Retrieved October 25, 2015, from <http://www.americantrails.org/NRTDatabase/trailList.php?usrTrailName=&usrTrailState=GA&usrTrailCounty=&usrTrailUse=>
- Amtrak. (2015a, October). *South Train Routes*. Retrieved October 18, 2015, from Amtrak: <http://www.amtrak.com/south-train-routes>
- Amtrak. (2015b, April 6). *Amtrak System Timetable*. Retrieved from Amtrak: <https://www.amtrak.com/ccurl/194/703/System-Timetable-Spring-Fall-2015.pdf>
- Anderson, D. G. (1995). Recent Advances in Paleoindian and Archaic Period Research in Southeastern United States. *Archaeology of Eastern North America*, 23, 145-176. Retrieved October 2015, from <http://www.jstor.org/stable/40914396>
- Anderson, D. G., & Schuldenrein, J. (1983). Mississippi Period in the Southern Piedmont: Evidence from the Rucker's Bottom Site, Elbert County, Georgia. *Southeastern Archaeology*, 2(2), 98-117. Retrieved October 2015, from <http://www.jstor.org/stable/40712785>
- Anderson, D. G., Miller, S., Yerka, S. J., Gillam, C., Johanson, E. N., Anderson, D. T., . . . Smallwood, A. M. (2010). PIDBA (Paleoindian Database of the Americas) 2010: Current Status and Findings. *Archaeology of Eastern North America*, 38, 63-89. Retrieved October 2015, from <http://www.jstor.org/stable/40914542>
- Appalachian Trail Conservancy. (2015). *Welcome to Georgia*. Retrieved October 2015, from <http://www.appalachiantrail.org/home/explore-the-trail/explore-by-state/Georgia>
- Atlanta Convention and Visitor's Bureau. (2015). *50 Fun Things to Do*. Retrieved October 2015, from <http://www.atlanta.net/50fun/#50fun>
- Atlanta International Airport. (2014a). *ATL Fact Sheet: General Information*. Retrieved June 2017, from <http://www.atl.com/about-atl/atl-factsheet/>
- Atlanta International Airport. (2014b, December). *Monthly Airport Traffic Report December 2014*. Retrieved June 2017, from <http://www.atl.com/docs/BusinessInformation/Traffic/201412.pdf>

- Balmori, A. (2005). Possible Effects of Electromagnetic Fields from Phone Masts on a Population of White Stork (*Ciconia ciconia*). *Electromagnetic Biology and Medicine*, 24, 109-119.
- Balmori, A. (2009). Electromagnetic Pollution from Phone Masts: Effects on Wildlife. *Pathophysiology: Electromagnetic Fields (EMF) Special Issue*, 16(2-3), 191-199.
- Balmori, A., & Hallberg, O. (2007). The Urban Decline of the House Sparrow (*Passer Domesticus*): A Possible Link with Electromagnetic Radiation. *Electromagnetic Biology and Medicine*, 26, 141-151.
- Beck, B. (1980). *An Introduction to Caves and Cave Exploring in Georgia*. Retrieved October 2015, from [https://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/GG5.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/GG5.pdf)
- Bense, J. A. (1996). Overview of the Mississippian Stage in the Southeastern United States. *Revista de Arqueología Americana*, 10, 53-71. Retrieved October 2015, from <http://www.jstor.org/stable/27768367>
- Berven, K., & Grudzien, T. (1990). Dispersal in the wood frog (*Rana sylvatica*): implications for genetic population structure. *Evolution, Volume 44*(Issue 8), 2047-2056. Retrieved from [http://www.jstor.org/stable/2409614?seq=1#page\\_scan\\_tab\\_contents](http://www.jstor.org/stable/2409614?seq=1#page_scan_tab_contents)
- Blitz, J. H. (2010). New Perspectives in Mississippian Archaeology. *Journal of Archaeological Research*, 18(1), 1-39. Retrieved May 2015, from <http://www.jstor.org/stable/23018388>
- BLM. (1984). *Manual 8400 - Visual Resource Management*. Washington, DC: Department of the Interior, Bureau of Land Management. Retrieved from [https://www.blm.gov/sites/blm.gov/files/program\\_recreation\\_visual%20resource%20management\\_quick%20link\\_BLM%20Manual%20Section%208400%20-%20Visual%20Resource%20Management.pdf](https://www.blm.gov/sites/blm.gov/files/program_recreation_visual%20resource%20management_quick%20link_BLM%20Manual%20Section%208400%20-%20Visual%20Resource%20Management.pdf)
- BLM. (2014, August). *DRECP Noise and Vibration*. Retrieved July 22, 2015, from [http://www.blm.gov/style/medialib/blm/ca/pdf/pa/energy/drecp/draft\\_drecp.Par.37401.File.dat/III.21%20Noise%20and%20Vibration.pdf](http://www.blm.gov/style/medialib/blm/ca/pdf/pa/energy/drecp/draft_drecp.Par.37401.File.dat/III.21%20Noise%20and%20Vibration.pdf)
- BLS. (2013a). *Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2013 (Georgia)*. Retrieved October 14, 2015, from <http://www.bls.gov/iif/oshwc/osh/os/pr136ga.pdf>
- BLS. (2013b). *Incidence rate and number of nonfatal occupational injuries by industry and ownership, 2013 (U.S.)*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/osh/os/ostb3966.pdf>
- BLS. (2013c). *Fatal occupational injuries to private sector wage and salary workers, government workers, and self-employed workers by industry, all United States, 2013*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/foi/cftb0279.pdf>
- BLS. (2014a, March 25). *Occupational Employment and Wages, May 2014: 49-9052 Telecommunications Line Installers and Repairers*. Retrieved September 25, 2015, from Occupational Employment Statistics: <http://www.bls.gov/oes/current/oes499052.htm>
- BLS. (2014b). *Table A-5. Fatal occupational injuries by occupation and event or exposure, all United States, 2014*. Retrieved September 29, 2015, from 2014 Census of Fatal Occupational Injuries (preliminary data): <http://www.bls.gov/iif/oshwc/foi/cftb0290.pdf>
- BLS. (2015a, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Georgia: [http://www.bls.gov/oes/current/oes\\_ga.htm](http://www.bls.gov/oes/current/oes_ga.htm)

- BLS. (2015b). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages*. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages, file staaadata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsenp16.htm>
- BLS. (2015c, March 25). *May 2014 State Occupational Employment and Wage Estimates Georgia*. Retrieved October 14, 2015, from Occupational Employment Statistics: [http://www.bls.gov/oes/current/oes\\_ga.htm#49-0000](http://www.bls.gov/oes/current/oes_ga.htm#49-0000)
- BLS. (2015d, April 22). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved October 14, 2015, from Injuries, Illnesses, and Fatalities: [http://www.bls.gov/iif/state\\_archive.htm#GA](http://www.bls.gov/iif/state_archive.htm#GA)
- BLS. (2015e, September 21). Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data. *Injuries, Illnesses, and Fatalities*. Retrieved September 18, 2015, from Census of FAtal Occupational Injuries (2011 forward): <http://www.bls.gov/iif/oshcfoi1.htm>
- BLS. (2016, March 30). *Telecommunications: NAICS 517*. Retrieved from Industries at a Glance: <http://www.bls.gov/iag/tgs/iag517.htm>
- Bond, S., Sims, S., & Dent, P. (Eds.). (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value*. Chichester, West Sussex, United Kingdom: Wiley-Blackwell.
- Calhoun, A., & DeMaynadier, P. (2007). Science and conservation of vernal pools in northeastern North America: ecology and conservation of seasonal wetlands in northeastern North America. *Science and conservation of vernal pools in northeastern North America: ecology and conservation of seasonal wetlands in northeastern North America*. Retrieved from [http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12\\_ScienceConservationofVernalPools.pdf](http://www.nae.usace.army.mil/Portals/74/docs/regulatory/VernalPools/Ch12_ScienceConservationofVernalPools.pdf)
- Carr, C., & Sears, D. W. (1985). Toward an Analysis of the Exchange of Meteoritic Iron in the Middle Woodland. *Southeastern Archaeology*, 4(2), 79-92. Retrieved August 5, 2016, from <http://www.jstor.org/stable/40712805>
- CEC. (2011, April). *North American Terrestrial Ecoregions - Level III*. Retrieved from Commission for Environmental Cooperation: [ftp://ftp.epa.gov/wed/ecoregions/pubs/NA\\_TerrestrialEcoregionsLevel3\\_Final-2june11\\_CEC.pdf](ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf)
- CEQ. (1997, December). *Environmental Justice: Guidance Under the National Environmental Policy Act*. Retrieved April 2015, from [http://energy.gov/sites/prod/files/nepapub/nepa\\_documents/RedDont/G-CEQ-EJGuidance.pdf](http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf)
- CEQ. (2016). *Final Guidance on Greenhouse Gases and Climate Change*. Retrieved June 2014, from National Environmental Policy Act: [https://ceq.doe.gov/guidance/ceq\\_guidance\\_nepa-ghg-climate\\_final\\_guidance.html](https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg-climate_final_guidance.html)
- CIO Council. (2015). *Data Center Consolidation and Optimization*. Retrieved from <https://cio.gov/drivingvalue/data-center-consolidation/>
- City of Atlanta Climate Action Plan*. (2015, August). Retrieved June 2017, from <http://p2catl.com/wp-content/uploads/Atlanta-Climate-Action-Plan-Presentation1.pdf>
- City of Lincoln. (2015). *What are Saline Wetlands?* Retrieved July 2015, from <http://lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandsinfo.htm>

- CivilWar.org. (2003). *Scorched Earth*. Retrieved from CivilWar.org:  
<http://www.civilwar.org/hallowed-ground-magazine/fall-2014/scorched-earth.html>
- Code of Georgia. (2017a). *Title 46 - Public Utilities and Public Transportation*. Retrieved June 2017, from 2010 Georgia Code: US Codes and Statutes:  
<http://law.justia.com/codes/georgia/2010/title-46>
- Code of Georgia. (2017b). *Title 6 - Aviation*. Retrieved June 2017, from 2010 Georgia Code: US Codes and Statutes: <http://law.justia.com/codes/georgia/2010/title-6>
- Code of Georgia. (2017c). *Title 40 - Motor Vehicles and Traffic*. Retrieved June 2017, from 2010 Georgia Code: US Codes and Statutes: <http://law.justia.com/codes/georgia/2010/title-40>
- Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31*. Retrieved April 5, 2015, from <http://www.fws.gov/wetlands/Documents/classwet/index.html>
- Crook, M. R. (2007, April). Prehistoric Pile Dwellers within an Emergent Ecosystem: An Archaeological Case of Hunters and Gatherers at the Mouth of the Savannah river during the Mid-Holocene. *Human Ecology*, 35(2), 223-237. Retrieved October 2015, from <http://www.jstor.org/stable/27654183>
- CSC. (2007, March). *Telecommunications Facilities: An Illustrated Primer on the Siting of Facilities within Connecticut and Throughout the Nation*. Retrieved from Connecticut Siting Council: [http://www.ct.gov/csc/lib/csc/csc\\_tower\\_3\\_07.pdf](http://www.ct.gov/csc/lib/csc/csc_tower_3_07.pdf)
- Custer, J. F., & Bachman, D. C. (1986). Prehistoric Use of Bay/Basin features on the Delmarva Peninsula. *Southeastern Archaeology*, 5(1), 1-10. Retrieved October 2015, from <http://www.jstor.org/stable/40713469>
- DCA. (2015, October). *FY 2011 Solid Waste Management Annual Report*. Retrieved October 2015, from Department of Community Affairs:  
<https://www.dca.ga.gov/development/Research/programs/swar2011.asp>
- De-Campos, A., Mamedov, A., & Huang, C.-h. (2009). Short-Term Reducing Conditions Decrease Aggregation. *Soil Science Society of America Journal*, 550-559. Retrieved November 2013, from <http://www.sciencedaily.com/releases/2009/04/090408140204.htm>
- Deganian, D. (2012). Environmental Justice on My Mind: Moving Georgia's Environmental Protection Division Toward the Consideration of Environmental Justice in Permitting. (T. L. Timmons, Ed.) *Barry Law's Earth Jurisprudence and Environmental Justice Journal*, 2(1), 33-59. Retrieved October 2015, from <http://lawpublications.barry.edu/cgi/viewcontent.cgi?article=1009&context=ejej>
- DiCarlo, A., White, F., Guo, P., & Litovitz, T. (2002). Chronic Electromagnetic Field Exposure decreases HSP70 Levels and Lowers Cytoprotection. *Cellular Biochemistry*, 447-454.
- DOE. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions*. Washington, DC: Department of Energy. Retrieved December 15, 2015, from <http://energy.gov/epsa/downloads/climate-change-and-us-energy-sector-regional-vulnerabilities-and-resilience-solutions>
- eBird. (2015). *eBird range map--bald eagle*. Retrieved from [http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&\\_\\_hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.1442877327577.1&\\_\\_hssc=75100365.4.1442877327577&\\_\\_hsfp=3470679313#\\_ga=1.21938685.790432658.1442877326](http://ebird.org/ebird/map/baleag?bmo=1&emo=12&byr=2011&eyr=2015&__hstc=75100365.64b7254677ac8cc5c8f21aa17c0b9689.1442877327577.1442877327577.1442877327577.1&__hssc=75100365.4.1442877327577&__hsfp=3470679313#_ga=1.21938685.790432658.1442877326)

- Edinger, G. J., Evans, D. J., Gebauer, S., Howard, T. G., Hunt, D. M., & Olivero, A. M. (2014, March). *Ecological Communities of New York State*. Retrieved March 19, 2015, from A revised and expanded edition of Carol Reschke's Ecological Communities of New York State.: <http://www.dec.ny.gov/animals/97703.html>
- EIA. (2011, July). *Greenhouse Gas Emissions Overview*. Retrieved 07 28, 2015, from Emissions of Greenhouse Gases in the United States:  
[http://www.eia.gov/environment/emissions/ghg\\_report/ghg\\_overview.cfm](http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm)
- EIA. (2014a). *Profile Overview- Georgia*. Retrieved October 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/?sid=ga#tabs-2>
- EIA. (2014b). *State CO2 Emissions - 1980 to 2013*. Retrieved April 26, 2016, from <http://www.eia.gov/environment/emissions/state/>
- EIA. (2015a). *Georgia State Energy Profile*. Retrieved November 2015, from <http://www.eia.gov/state/print.cfm?sid=GA>
- EIA. (2015b, August). *Glossary*. Retrieved July 2015, from U.S. Energy Information Administration: <http://www.eia.gov/tools/glossary/index.cfm?id=B>
- EIA. (2015c, October). *Georgia - State Profile and Energy Estimates*. Retrieved April 2016, from <https://www.eia.gov/state/?sid=GA>
- EIA. (2016). *Glossary - Electricity*. Retrieved from U.S. Energy Information Administration: <https://www.eia.gov/tools/glossary/?id=electricity>
- EIA. (2017a, February). *Electric Power Monthly*. Retrieved June 2017, from U.S. Energy Information Administration:  
[https://www.eia.gov/electricity/monthly/current\\_year/february2017.pdf](https://www.eia.gov/electricity/monthly/current_year/february2017.pdf)
- EIA. (2017b, January). *Energy-Related CO2 Emissions at the State Level, 2000-2013*. Retrieved June 2017, from <http://www.eia.gov/environment/emissions/state/analysis/>
- Engels, S., Schneider, N.-L., Lefeldt, N., Hein, C., Zapka, M., Michalik, A., . . . Mouritsen, H. (2014, May 15). Anthropogenic Electromagnetic Noise Disrupts Magnetic Compass Orientation in a Migratory Bird. *Nature*. doi:10.1038/nature13290
- ETK. (2017). *The Largest Earthquakes in Georgia*. Retrieved June 2017, from Earthquake Track: <http://earthquaketrack.com/p/united-states/georgia/biggest>
- Executive Office of the President. (1994, February). *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Retrieved April 2015, from 59 Federal Register 7629: <https://federalregister.gov/a/94-3685>
- FAA. (2008). *Chapter 14 Airspace*. Retrieved June 2015, from Pilot's Handbook of Aeronautical Knowledge:  
[http://www.faa.gov/regulations\\_policies/handbooks\\_manuals/aviation/pilot\\_handbook/media/phak%20-%20chapter%2014.pdf](http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2014.pdf)
- FAA. (2012a, April 5). *Advisory Circular AC 36-3H*. Retrieved July 22, 2015, from [http://www.faa.gov/documentLibrary/media/Advisory\\_Circular/AC36-3H%20Chg%201.pdf](http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.pdf)
- FAA. (2012b). *Evaluation for new obstruction lighting techniques to reduce avian fatalities*. Retrieved from <http://www.tc.faa.gov/its/worldpac/techrpt/tctn12-9.pdf>
- FAA. (2013). *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Washington D.C.: U.S. Department of Transportation Federal Aviation Administration.

- FAA. (2014, January). *Federal Aviation Administration, Air Traffic Organization*. Retrieved June 2015, from [http://www.faa.gov/about/office\\_org/headquarters\\_offices/ato/](http://www.faa.gov/about/office_org/headquarters_offices/ato/)
- FAA. (2015a, June 25). *Airport Data and Contact Information*. Retrieved October 18, 2015, from [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)
- FAA. (2015b, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from [http://www.faa.gov/about/office\\_org/field\\_offices/fsdo/](http://www.faa.gov/about/office_org/field_offices/fsdo/)
- FAA. (2015c). *Aeronautical Information Manual*. Retrieved August 2015, from [http://www.faa.gov/air\\_traffic/publications/media/aim.pdf](http://www.faa.gov/air_traffic/publications/media/aim.pdf)
- FAA. (2015d). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration: <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>
- FAA. (2015e, August 6). *FAA Air Traffic Organization Policy, JO 7400.9SZ, Airspace Designations and Reporting Points*. (F. A. U.S. Department of Transportation, Producer) Retrieved October 2015, from FAA, Regulations & Policies, Orders & Notices: [http://www.faa.gov/regulations\\_policies/orders\\_notices/index.cfm/go/document.list/parentTopicID/10](http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.list/parentTopicID/10)
- FAA. (2015f). *Air Traffic Organization Policy Order JO 7400.8Y Subject: Special Use Airspace*. Retrieved July 2015, from [http://www.faa.gov/documentLibrary/media/Order/7400.8y\\_\(2016\).pdf](http://www.faa.gov/documentLibrary/media/Order/7400.8y_(2016).pdf)
- FAA. (2015g). *FAA TFR List*. Retrieved July 2015, from <http://tfr.faa.gov/tfr2/list.html>
- FAA. (2015h). *Hearing and Noise in Aviation*. Retrieved June 2017, from <https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing.pdf>
- FAA. (2015i). *FAA Air Traffic Activity System (ATADS) data*. Retrieved 10 27, 2015, from <http://aspm.faa.gov/opsnet/sys/Airport.asp>
- FAA. (2016a, April). *Volume 7: Investigation - Chapter 5: Conduct a Complaint Investigation*. Retrieved June 2017, from Federal Aviation Administration - US Department of Transportation: [http://fsims.faa.gov/wdocs/8900.1/v07%20investigation/chapter%2005/07\\_005\\_001.htm](http://fsims.faa.gov/wdocs/8900.1/v07%20investigation/chapter%2005/07_005_001.htm)
- FAA. (2016b). *Flight Standards District Offices (FSDO) - Georgia*. Retrieved June 2017, from [https://www.faa.gov/about/office\\_org/field\\_offices/fsdo/?state=GA](https://www.faa.gov/about/office_org/field_offices/fsdo/?state=GA)
- FAA. (2016c, October 8). *Obstruction Marking and Lighting: AC 70/7460-IL Change 1*. Retrieved from [www.faa.gov](http://www.faa.gov): [https://www.faa.gov/documentLibrary/media/Advisory\\_Circular/AC\\_70\\_7460-1L\\_Change\\_1\\_Obstruction\\_Marking\\_and\\_Lighting\\_10062016.pdf](https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_1_Obstruction_Marking_and_Lighting_10062016.pdf)
- FAA. (2016d, September 28). *Specification for Obstruction Lighting: AC No: 150/5345-43H*. Retrieved from [www.faa.gov](http://www.faa.gov): [https://www.faa.gov/documentLibrary/media/Advisory\\_Circular/150-5345-43GH.pdf](https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5345-43GH.pdf)
- FAO. (2000). *Land Cover Classification System*. Retrieved June 2017, from Food and Agriculture Organization of the United Nations: Natural Resources Management and Environment Department: <http://www.fao.org/docrep/003/x0596e/x0596e01e.htm>
- FCC. (2000, August). *Deployment of Advanced Telecommunications Capability: Second Report*. Retrieved Nov 16, 2015, from [https://transition.fcc.gov/Bureaus/Common\\_Carrier/Orders/2000/fcc00290.pdf](https://transition.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00290.pdf)
- FCC. (2012, March 13). *Final Programmatic Environmental Assessment for the Antenna Structure Registration Program*. Retrieved from [https://apps.fcc.gov/edocs\\_public/attachmatch/DOC-312921A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf)

- FCC. (2014a). *Internet Access Services: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau. Federal Communications Commission.
- FCC. (2014b). *Local Telephone Competition: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau.
- FCC. (2015, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission:  
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>
- FCC. (2016a, March). *National Broadband Plan Chapter 16 Public Safety*. Retrieved March 29, 2016, from Broadband.gov: <http://www.broadband.gov/plan/16-public-safety/>
- FCC. (2016b, February 3). *Narrowbanding Overview*. Retrieved from Technologies, Systems and Innovation Design: <https://www.fcc.gov/general/narrowbanding-overview>
- FCC. (2016c). *911 Master PSAP Registry*. PSAP Registry Data Report. Retrieved from <https://www.fcc.gov/general/9-1-1-master-psap-registry>
- FCC. (2016d, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from <https://www.fcc.gov/general/tower-and-antenna-siting>
- FCC. (2016e, June). *Detail - Microwave*. Retrieved from Application Search Help: [http://wireless2.fcc.gov/helpfiles/applicationSearch/ad\\_microwave.html](http://wireless2.fcc.gov/helpfiles/applicationSearch/ad_microwave.html)
- FCC. (2017, January 6). *Opportunities to Reduce Bird Collisions with Communications Towers*. Retrieved from [www.fcc.gov](http://www.fcc.gov):  
[https://www.fcc.gov/sites/default/files/light\\_changes\\_information\\_update\\_Jan\\_2017.pdf](https://www.fcc.gov/sites/default/files/light_changes_information_update_Jan_2017.pdf)
- Federal Mining Dialogue. (2015, January 6). *Abandoned Mine Lands Portal - Staying Safe*. Retrieved September 29, 2015, from <http://www.abandonedmines.gov/ss.html>
- FEMA. (2000). *44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) Regulations: Definitions of NFIP Terms*. Retrieved May 2015, from <http://www.fema.gov/media-library/assets/documents/12437?id=3064>
- FEMA. (2007). *Session 7: Nature and Effects of Earthquake Hazards*. Retrieved from Federal Emergency Management Agency:  
<https://training.fema.gov/emiweb/downloads/earthquakeem/session%2007/session%207%20nature%20and%20effects.pdf>
- FEMA. (2010, March). *Guidelines for Estimation of Percolation losses for NFIP Studies*. Retrieved August 6, 2015, from FEMA: [http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl\\_perc.pdf](http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf)
- FEMA. (2013). *Unit 3: NFIP Flood Studies and Maps*. Retrieved May 2015, from [http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip\\_sg\\_unit\\_3.pdf](http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip_sg_unit_3.pdf)
- FEMA. (2014a, May). *Chapter 8: Floodplain Natural Resources and Functions*. Retrieved May 2015, from <https://training.fema.gov/hiedu/docs/fmc/chapter%208%20-%20floodplain%20natural%20resources%20and%20functions.pdf>
- FEMA. (2014b, May). *Chapter 2: Types of Floods and Floodplains*. Retrieved May 2015, from <http://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf>
- FEMA. (2014c, May). *Community Rating System*. Retrieved May 2015, from [http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS\\_Communitites\\_May\\_1\\_2014.pdf](http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communitites_May_1_2014.pdf)
- FEMA. (2015a, October 26). *Community Status Book Report Georgia*. Retrieved October 26, 2015, from <http://www.fema.gov/cis/GA.html>

- FEMA. (2015b, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from <https://www.fema.gov/floodplain-management-fact-sheet>
- Fenneman, N. (1916). *Physiographic Subdivision of the United States*. Retrieved April 2015, from <http://www.pnas.org/content/3/1/17.full.pdf?ck=nck>
- FGDC. (2013, August). *Classification of Wetlands and Deepwater Habitats of the United States*. Retrieved April 17, 2015, from FGDC Subcommittee on Wetlands Data: <http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013>
- FHWA. (2009, October). *Advances in Wildlife Crossing Technologies*. Retrieved July 12, 2016, from Public Roads: <http://www.fhwa.dot.gov/publications/publicroads/09septoct/03.cfm>
- FHWA. (2011, July 14). *Highway Traffic and Construction Noise*. Retrieved July 27, 2015, from [fhwa.dot.gov: http://www.fhwa.dot.gov/environment/noise/regulations\\_and\\_guidance/probresp.cfm#appendix](http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix)
- FHWA. (2013, September 3). *National Scenic Byways Program - Intrinsic Qualities: Identification and Distinctions*. Retrieved May 2016, from [http://www.fhwa.dot.gov/hep/scenic\\_byways/byway\\_quality/analysis/iq\\_identification.cfm](http://www.fhwa.dot.gov/hep/scenic_byways/byway_quality/analysis/iq_identification.cfm)
- FHWA. (2014, October 21). *Public Road Length*. Retrieved October 18, 2015, from <http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm>
- FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved October 18, 2015, from <http://www.fhwa.dot.gov/bridge/nbi/no10/county14a.cfm#ga>
- FHWA. (2015b, October). *Route Log and Finder List*. Retrieved October 18, 2015, from Federal Highway Administration: [http://www.fhwa.dot.gov/planning/national\\_highway\\_system/interstate\\_highway\\_system/routefinder/index.cfm](http://www.fhwa.dot.gov/planning/national_highway_system/interstate_highway_system/routefinder/index.cfm)
- FHWA. (2015c, October). *Russell-Brasstown National Scenic Byway*. Retrieved October 18, 2015, from <http://www.fhwa.dot.gov/byways/byways/13739>
- FHWA. (2015d). *America's Byways: Georgia*. Retrieved October 25, 2015, from <http://www.fhwa.dot.gov/byways/states/GA>
- FHWA. (2015e, 05 28). *Highway Traffic Noise*. Retrieved 07 22, 2015, from [http://www.fhwa.dot.gov/environment/noise/regulations\\_and\\_guidance/faq\\_nois.cfm](http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm)
- Fiber Optic Association. (2010). *Guide to Fiber Optics & Premises Cabling*. Retrieved September 21, 2015, from Safety in Fiber Optic Installations: <http://www.thefoa.org/tech/safety.htm>
- FRA. (2015). *Federal Railroad Administration Horn Noise FAQ*. Retrieved 07 22, 2015, from <https://www.fra.dot.gov/Page/P0599>
- FTA. (2006). *Transit Noise and Vibration Impact Assessment*. Retrieved from Federal Transit Authority: [https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA\\_Noise\\_and\\_Vibration\\_Manual.pdf](https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf)
- Fulton County Government. (2013). *Fulton Board Adopts Innovative Environmental Justice Policy*. Retrieved October 2015, from <http://www.fultoncountyga.gov/latest-news/6229-fulton-board-adopts-innovative-environmental-justice-policy>
- GA R&R. (2015a, October). *Rule 391-3-1-.01 Definitions - Amended*. Retrieved October 23, 2015, from Rules and Regulations of the State of Georgia: <http://rules.sos.ga.gov/gac/391-3-1>

- GA R&R. (2015b, September 18). *Rule 391-3-1-.03 Permits - Amended*. Retrieved October 23, 2015, from Rules and Regulations of the State of Georgia:  
<http://rules.sos.ga.gov/GAC/391-3-1-.03>
- GA R&R. (2017a). *Department 515 - Rules of Georgia Public Service Commission*. Retrieved June 2017, from Rules and Regulations of the State of Georgia:  
<http://rules.sos.state.ga.us/gac/515>
- GA R&R. (2017b). *Department 511 - Rules to Georgia Department of Public Health*. Retrieved June 2017, from Rules and Regulations of the State of Georgia:  
<http://rules.sos.state.ga.us/gac/511>
- GA R&R. (2017c). *Department 266 - Georgia Emergency Management Agency*. Retrieved June 2017, from Rules and Regulations of the State of Georgia:  
<http://rules.sos.state.ga.us/gac/266>
- GA R&R. (2017d). *Department 391: Subject 391-3-3 Surface Mining*. Retrieved June 2017, from <http://rules.sos.ga.gov/GAC/391-3-3>
- GA R&R. (2017e). *Department 391: Subject 391-3-2 Groundwater Use*. Retrieved June 2017, from <http://rules.sos.ga.gov/GAC/391-3-2>
- GADCA. (2014, January). *Georgia State Amendments to the International Building Code (2012 Edition)*. Retrieved June 2017, from Georgia Department of Community Affairs:  
[http://www.dca.state.ga.us/development/ConstructionCodes/programs/documents/2012IBC2014Amendments\\_001.pdf](http://www.dca.state.ga.us/development/ConstructionCodes/programs/documents/2012IBC2014Amendments_001.pdf)
- GADED. (2015). *Silver Lake Wildlife Management Area*. Retrieved October 2015, from <http://www.exploregeorgia.org/listing/4146-silver-lake-wildlife-management-area>
- GADNR. (2001). *Georgia Ecoregions: Maps and Descriptions*. Retrieved from Georgia Department of Natural Resources: <http://www.georgiawildlife.com/node/1704>
- GADNR. (2003). *Feral Hogs in Georgia - Disease, Damage, and Control*. Retrieved from Georgia Department of Natural Resources: <http://feralhogs.tamu.edu/files/2010/05/Feral-Hogs-in-Georgia.pdf>
- GADNR. (2005a). *Comprehensive Wildlife Conservation Strategy for Georgia*. Retrieved October 23, 2015, from Georgia Department of Natural Resources:  
<http://www1.gadnr.org/cwcs/Documents/strategy.html>
- GADNR. (2005b). *Appendix G: Laws And Regulations Affecting Wildlife In Georgia*. Retrieved June 2017, from Georgia Department of Natural Resources:  
[http://www1.gadnr.org/cwcs/PDF/Appendix\\_G.pdf](http://www1.gadnr.org/cwcs/PDF/Appendix_G.pdf)
- GADNR. (2008a). *Cyprinella caerulea - Blue Shiner*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/s/fishes/cyprinella\\_caerulea.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/s/fishes/cyprinella_caerulea.pdf)
- GADNR. (2008b). *Medionidus acutissimus - Alabama Moccasinshell*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/s/invertebrates/medionidus\\_acutissimus.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/s/invertebrates/medionidus_acutissimus.pdf)
- GADNR. (2009a). *Georgia Invasive Species Strategy*. Retrieved from <http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/GeorgiaInvasiveSpeciesStrategy.pdf>
- GADNR. (2009b). *Striped Newt*. Retrieved July 20, 2016, from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/amphibians/notophthalmus\\_perstriatus.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/amphibians/notophthalmus_perstriatus.pdf)

- GADNR. (2009c). *Myotis grisescens* - Gray Bat. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/myotis\\_grisescens.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/myotis_grisescens.pdf)
- GADNR. (2009d). *Myotis sodalis* - Indiana Bat. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/myotis\\_sodalis.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/myotis_sodalis.pdf)
- GADNR. (2009e). *Megaptera novaeangliae* - Humpback Whale. Retrieved from [http://www.georgiawildlife.org/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/megaptera\\_novaeangliae.pdf](http://www.georgiawildlife.org/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/megaptera_novaeangliae.pdf)
- GADNR. (2009f). *Eubalaena glacialis* - North Atlantic Right Whale. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/eubalaena\\_glacialis.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/eubalaena_glacialis.pdf)
- GADNR. (2009g). *Trichechus manatus* - West Indian Manatee. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/trichechus\\_manatus.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/mammals/trichechus_manatus.pdf)
- GADNR. (2009h). *Drymarchon corais couperi* - Eastern Indigo Snake. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/drymarchon\\_couperi.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/drymarchon_couperi.pdf)
- GADNR. (2009i). *Ambystoma spp* - Flatwoods Salamanders. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/amphibians/ambystoma\\_cingulatum.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/amphibians/ambystoma_cingulatum.pdf)
- GADNR. (2009j). *Etheostoma scotti* - Cherokee Darter. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/etheostoma\\_scotti.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/etheostoma_scotti.pdf)
- GADNR. (2009k). *Percina jenkinsi* - Conasauga Logperch. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina\\_jenkinsi.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina_jenkinsi.pdf)
- GADNR. (2009l). *Etheostoma etowahae* - Etowah Darter. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/etheostoma\\_etowahae.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/etheostoma_etowahae.pdf)
- GADNR. (2009m). *Percina aurolineata* - Goldline Darter. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina\\_aurolineata.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina_aurolineata.pdf)
- GADNR. (2009n). *Percina tanasi* - Snail darter. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina\\_tanasi.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina_tanasi.pdf)
- GADNR. (2010a). *Charadrius melodus* - Piping Plover. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/charadrius\\_melodus.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/charadrius_melodus.pdf)
- GADNR. (2010b). *Picoides borealis* - Red-Cockaded Woodpecker. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/picoides\\_borealis.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/picoides_borealis.pdf)
- GADNR. (2010c). *Calidris canutus* - Red Knot. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/calidris\\_canutus.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/calidris_canutus.pdf)

- GADNR. (2010d). *Mycteria americana* - *Wood Stork*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/mycteria\\_america.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/mycteria_america.pdf)
- GADNR. (2010e). *Percina antesella* - *Amber Darter*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina\\_antesella.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina_antesella.pdf)
- GADNR. (2010f). *Torreyia taxifolia* - *Florida Torreyia*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/torreyia\\_taxifolia.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/torreyia_taxifolia.pdf)
- GADNR. (2010g). *Baptisia arachnifera* - *Hairy Rattleweed*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/baptisia\\_arachnifera.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/baptisia_arachnifera.pdf)
- GADNR. (2010h). *Scutellaria montana* - *Large-Flowered Skullcap*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/scutellaria\\_montana.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/scutellaria_montana.pdf)
- GADNR. (2010i). *Trillium persistens* - *Persistent Trillium*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/trillium\\_persistens.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/plants/trillium_persistens.pdf)
- GADNR. (2011a). *Eretmochelys imbricata* - *Hawksbill Sea Turtle*. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/eretmochelys\\_imbricata.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/eretmochelys_imbricata.pdf)
- GADNR. (2011b). *Lepidochelys kempii* - *Kemp's Ridley Sea Turtle*. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/lepidochelys\\_kempii.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/lepidochelys_kempii.pdf)
- GADNR. (2011c). *Dermochelys coriacea* - *Leatherback Sea Turtle*. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/dermochelys\\_coriacea.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/dermochelys_coriacea.pdf)
- GADNR. (2011d). *Caretta caretta* - *Loggerhead Sea Turtle*. Retrieved from [http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/caretta\\_caretta.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/caretta_caretta.pdf)
- GADNR. (2011e). *Elliptio spinosa* - *Altamaha Spiny mussel*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/invertebrates/elliptio\\_spinosa.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/invertebrates/elliptio_spinosa.pdf)
- GADNR. (2012). *Water Quality in Georgia 2010-2011*. Retrieved October 23, 2015, from [http://epd.georgia.gov/sites/epd.georgia.gov/files/Y2012\\_Chapter\\_3-5\\_305b.pdf](http://epd.georgia.gov/sites/epd.georgia.gov/files/Y2012_Chapter_3-5_305b.pdf)
- GADNR. (2013). *Acipenser brevirostrum* - *Shortnose Sturgeon*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/acipenser\\_brevirostrum.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/acipenser_brevirostrum.pdf)
- GADNR. (2014, September). *Georgia's Statewide Nonpoint Source Management Plan FFY2014 Update*. Retrieved October 23, 2015, from [http://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/Georgia\\_Nonpoint\\_Source\\_Management\\_Plan\\_2014.pdf](http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/Georgia_Nonpoint_Source_Management_Plan_2014.pdf)
- GADNR. (2015a). *Sapelo Island National Estuarine Research Reserve*. Retrieved October 23, 2015, from <http://www.georgiawildlife.com/Education/Sapelo>

- GADNR. (2015aa, October). *2015 Ambient Air Monitoring Plan*. Retrieved October 23, 2015, from Georgia Department of Natural Resources:  
[http://www.air.dnr.state.ga.us/amp/2015\\_Ambient\\_Air\\_Monitoring\\_Plan.pdf](http://www.air.dnr.state.ga.us/amp/2015_Ambient_Air_Monitoring_Plan.pdf)
- GADNR. (2015ab, October). *Ambient Monitoring Program - Annual Data Reports*. Retrieved October 23, 2015, from Georgia Department of Natural Resources:  
<http://www.air.dnr.state.ga.us/amp/report.php>
- GADNR. (2015ac, October). *Ambient Monitoring Program*. Retrieved October 23, 2015, from Georgia Department of Natural Resources:  
<http://www.air.dnr.state.ga.us/tmp/exceedances/index.php?yr=2014>
- GADNR. (2015b). *High Priority Waters*. Retrieved October 23, 2015, from  
<http://www.georgiawildlife.com/node/1377>
- GADNR. (2015c). *Wildlife Management Areas*. Retrieved October 29, 2015, from  
<http://www.georgiawildlife.com/hunting/wildlife-management-areas>
- GADNR. (2015d). *Georgia rare species and natural community data*. Retrieved from  
[http://www.georgiawildlife.com/rare\\_species\\_locations](http://www.georgiawildlife.com/rare_species_locations)
- GADNR. (2015e). *Georgia's Natural Communities and Associated Rare Plant and Animal Species: Thumbnail Accounts*. Retrieved July 20, 2016, from  
[http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/natural\\_communities\\_thumbnail\\_accounts.pdf](http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/natural_communities_thumbnail_accounts.pdf)
- GADNR. (2015f). *2015-2016 Georgia Hunting Season Dates and Limits*. Retrieved from  
[http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/hunting/pdf/regulations/2015-2016\\_StateSeason\\_summary.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/hunting/pdf/regulations/2015-2016_StateSeason_summary.pdf)
- GADNR. (2015g, February 24). *First Georgia Golden Eagle Added to Regional Tracking Project*. Retrieved July 20, 2016, from <http://www.georgiawildlife.com/node/3817>
- GADNR. (2015h). *Alligator Hunting Season for 2015*. Retrieved from  
<http://www.georgiawildlife.com/Hunting/Alligator>
- GADNR. (2015i). *Marine Turtle Stranding Network and At-Sea Recovery*. Retrieved from  
<http://www.georgiawildlife.org/Conservation/SeaTurtles>
- GADNR. (2015j). *Marine Fishes of Georgia*. Retrieved from  
<http://www.marinefishesofgeorgia.org/>
- GADNR. (2015k). *Trout Fishing in Georgia*. Retrieved from  
<http://www.georgiawildlife.com/Fishing/Trout>
- GADNR. (2015l). *Freshwater Fishes Page*. Retrieved from  
<http://georgiawildlife.com/node/1918>
- GADNR. (2015m). *Aquatic Nuisance Species Profiles*. Retrieved from  
<http://www.georgiawildlife.com/node/1040>
- GADNR. (2015n). *Invasive Species - They Threaten Our Native Populations*. Retrieved from  
<http://www.georgiawildlife.com/node/435>
- GADNR. (2015o). *Georgia Department of Natural Resources*. Retrieved December 10, 2015, from <http://www.gadnr.org>
- GADNR. (2015p). *Magnolia Springs State Park*. Retrieved October 2015, from  
<http://gastateparks.org/MagnoliaSprings>
- GADNR. (2015q). *Hamburg State Outdoor Recreation Area*. Retrieved October 2015, from  
<http://gastateparks.org/Hamburg>
- GADNR. (2015r). *Richard B. Russell State Park*. Retrieved October 2015, from  
<http://gastateparks.org/RichardBRussell>

- GADNR. (2015s). *Bobby Brown Park*. Retrieved October 2015, from <http://gastateparks.org/BobbyBrown>
- GADNR. (2015t). *Elijah Clark State Park*. Retrieved October 2015, from <http://gastateparks.org/ElijahClark>
- GADNR. (2015u). *Seminole State Park*. Retrieved October 2015, from <http://gastateparks.org/Seminole>
- GADNR. (2015v). *Historic Sites*. Retrieved October 25, 2015, from <http://gastateparks.org/historic/>
- GADNR. (2015w). *Park Locations*. Retrieved October 25, 2015, from <http://gastateparks.org/find/>
- GADNR. (2015x). *Amicalola Falls State Park and Lodge*. Retrieved October 26, 2015, from <http://gastateparks.org/AmicalolaFalls>
- GADNR. (2015y). *Georgia State Parks and Historic Sites - Amicalola Falls State Park and Lodge*. Retrieved October 25, 2015, from <http://gastateparks.org/AmicalolaFalls/gallery>
- GADNR. (2015z). *Wildlife Management Area Maps*. Retrieved October 25, 2015, from <http://georgiawildlife.com/maps/hunting>
- GADNR. (2016a). *Golden Eagle Tracking*. Retrieved July 20, 2016, from Bird Conservation: <http://georgiawildlife.com/GoldenEagles>
- GADNR. (2016b, May). *Goldline Darter*. Retrieved from [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina\\_aurolineata.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/fishes/percina_aurolineata.pdf)
- GADNR. (2016d). *Reptile Profiles*. Retrieved from Wildlife Resources Division: [http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/graptemys\\_pulchra.pdf](http://www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/reptiles/graptemys_pulchra.pdf)
- GADNR. (2016e). *Freshwater Mussels of Georgia*. Retrieved July 21, 2016, from Wildlife Resources Division: <http://georgiawildlife.com/FreshwaterMussels>
- GADNR. (2017a). *Marsh Permits: Coastal Marshlands Protection Act*. Retrieved June 2017, from Coastal Resources Division, Georgia Department of Natural Resources: <http://coastalgadnr.org/msp/ap/marsh>
- GADNR. (2017b). *Federal Consistency - State Laws under Federal Consistency*. Retrieved June 2017, from Coastal Resources Division, Georgia Department of Natural Resources: <http://coastalgadnr.org/msp/fedstatelaws>
- GADNR. (2017c). *State Laws*. Retrieved June 2017, from Historic Preservation Division, Georgia Department of Natural Resources: <http://georgiashpo.org/laws>
- GADNR, Coastal Resources Division. (2011, September). *Georgia Coastal and Estuarine Land Conservation Program*. Retrieved October 23, 2015, from <http://coastalgadnr.org/sites/uploads/crd/GA%20CELCP%20Plan%20FINAL%2011-11.pdf>
- GADNR, Coastal Resources Division. (2015). *Georgia's Salt Marshes*. Retrieved October 23, 2015, from <http://coastalgadnr.org/eo/sm>
- GADNR, Historic Preservation Division. (1991). *Georgia's Living Places: Historic Houses in Their Landscaped Settings*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources. Retrieved October 2015, from [http://georgiashpo.org/sites/uploads/hpd/pdf/NR15arch\\_20080521100904\\_optimized.pdf](http://georgiashpo.org/sites/uploads/hpd/pdf/NR15arch_20080521100904_optimized.pdf)

- GADNR, Historic Preservation Division. (2012). *Georgia's State Historic Preservation Plan 2012-2016: Partnering for Preservation*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources.
- GADNR, Historic Preservation Division. (2015a). *House Types in Georgia*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources. Retrieved October 2015, from <http://georgiashpo.org/sites/uploads/hpd/pdf/housetypes.pdf>
- GADNR, Historic Preservation Division. (2015b). *Commercial Types in Georgia*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources. Retrieved October 2015, from [http://georgiashpo.org/sites/uploads/hpd/pdf/commercial\\_types.pdf](http://georgiashpo.org/sites/uploads/hpd/pdf/commercial_types.pdf)
- GADNR, Historic Preservation Division. (2016a). *Church Types in Georgia*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources.
- GADNR, Historic Preservation Division. (2016b). *School Types in Georgia*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources. Retrieved October 2015, from [http://georgiashpo.org/sites/uploads/hpd/pdf/school\\_types.pdf](http://georgiashpo.org/sites/uploads/hpd/pdf/school_types.pdf)
- GADOT. (2009). *An Overview and Analysis of the Middle Archaic in Georgia*. Retrieved August 8, 2016, from [http://www.dot.ga.gov/BuildSmart/Programs/CulturalResources/Documents/Reports/Occasional\\_Paper\\_16.pdf](http://www.dot.ga.gov/BuildSmart/Programs/CulturalResources/Documents/Reports/Occasional_Paper_16.pdf)
- GADOT. (2015a, October). *About Georgia DOT*. Retrieved October 18, 2015, from <http://www.dot.ga.gov/AboutGDOT>
- GADOT. (2015b, March). *Georgia State Rail Plan Executive Summary*. Retrieved October 18, 2015, from <http://www.dot.ga.gov/InvestSmart/Rail/Documents/StateRailPlan/2015GeorgiaStateRailPlan-1-26-16.pdf>
- GADOT. (2015c, October). *Scenic Byways*. Retrieved October 18, 2015, from <http://www.dot.ga.gov/DS/Travel/Scenic>
- GADOT. (2015d). *GADOT, Invest Smart, Airport Aid*. Retrieved October 2015, from <http://www.dot.ga.gov/IS/Aviation>
- GADOT. (2015e). *GADOT Rail Map*. Retrieved 10 27, 2015, from <http://www.dot.ga.gov/InvestSmart/Rail#tab-1>
- GADPH. (2012, September 5). *Public Health Assessment*. Retrieved October 15, 2015, from <http://www.atsdr.cdc.gov/HAC/pha/ArmstrongWorldIndustries/ArmstrongWorldIndustriesPCPHA09052012.pdf>
- GADPH. (2015a, October). *Wastewater Management Septic Tanks, On-Site Sewage, Portable Toilets*. Retrieved October 2015, from Department of Public Health: <https://dph.georgia.gov/wastewater-management>
- GADPH. (2015b). *Georgia Occupational Health and Safety Surveillance Program*. Retrieved October 15, 2015, from <https://dph.georgia.gov/georgia-occupational-health-and-safety-surveillance-program>
- GADPH, Office of Health Indicators for Planning. (2015). Online Analytical Statistical Information Tool (OASIS), Mortality/Morbidity Web Query Tool. Georgia. Retrieved October 22, 2015, from <https://oasis.state.ga.us/oasis/oasis/qryMorbMort.aspx>
- GADPS. (2010, August 17). *Georgia Dept. of Public Safety (GIN)-GA Interoperable System Rollout*. Retrieved September 23, 2015, from [www.gainterop.com](http://www.gainterop.com)
- GAEMC. (2012, August). *Georgia's Climate*. Retrieved from [www.ga-sites.com/\\_literature\\_108008/Climate](http://www.ga-sites.com/_literature_108008/Climate)

- GAEPD. (2015a, June). *Public Water System 2014 Compliance Summary Report*. Retrieved October 2015, from Environmental Protection Division: [http://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/2014%20Annual%20Drinking%20Water%20Compliance%20Summary%20Report.pdf](http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/2014%20Annual%20Drinking%20Water%20Compliance%20Summary%20Report.pdf)
- GAEPD. (2015b, October). *Wastewater (NPDES & LAS) Forms*. Retrieved October 2015, from Environmental Protection Division: <https://epd.georgia.gov/wastewater-npdes-las-forms>
- GAEPD. (2015c, October). *Solid Waste*. Retrieved October 2015, from Environmental Protection Division: <https://epd.georgia.gov/solid-waste>
- GAEPD. (2015d, October). *Permitted Solid Waste Facilities*. Retrieved October 2015, from Environmental Protection Division: <https://epd.georgia.gov/permitted-solid-waste-facilities>
- GAEPD. (2015e, May). *Water Use Classifications and Water Quality Standards*. Retrieved June 2017, from Environmental Protection Division: [http://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/EPA\\_Approved\\_WQS\\_May\\_1\\_2015.pdf](http://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/EPA_Approved_WQS_May_1_2015.pdf)
- GAEPD. (2015f, July 1). *Hazardous Site Inventory*. Retrieved October 14, 2015, from [https://epd.georgia.gov/sites/epd.georgia.gov/files/2015hsi\\_Complete/2015%20Introduction.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/2015hsi_Complete/2015%20Introduction.pdf)
- GAEPD. (2015g). *Voluntary Remediation*. Retrieved October 14, 2015, from <http://epd.georgia.gov/voluntary-remediation>
- GAEPD. (2017a). *NPDES Industrial Storm Water General Permits*. Retrieved June 2017, from Environmental Protection Division: <https://epd.georgia.gov/npdes-industrial-storm-water-general-permits>
- GAEPD. (2017b). *Watershed Assessment and Protection Plan Guidance Documents*. Retrieved June 2017, from Environmental Protection Division: <https://epd.georgia.gov/watershed-assessment-and-protection-plan-guidance-documents>
- GAEPPC. (2015, October 20). *GA-EPPC*. Retrieved October 20, 2015, from <http://www.gaeppc.org/list>
- GAGOV. (2014). *2014 State of Georgia Hazard Mitigation Strategy*. Retrieved June 2017, from Georgia Emergency Management Agency: <http://www.gema.ga.gov/Mitigation/Documents/Planning/2014%20GHMS.pdf>
- GAGOV. (2015). *Earthquakes: Drop, Cover, Hold On*. Retrieved October 2015, from <http://ready.ga.gov/be-informed/earthquakes/>
- GAO. (2013). *Data Center Consolidation: Strengthened Oversight Needed to Achieve Billions of Dollars in Savings*. Retrieved from <http://www.gao.gov/products/GAO-13-627T>
- GAPorts. (2015a, October). *Administrative Offices*. Retrieved October 2015, from Georgia Port Authority: <http://www.gaports.com/About/AdministrativeOffices.aspx>
- GAPorts. (2015b, October). *Port of Savannah*. Retrieved October 2015, from Georgia Ports Authority: <http://www.gaports.com/PortofSavannah.aspx>
- GAPorts. (2015c, October). *Savannah Harbor Deepening Expansion*. Retrieved October 2015, from Georgia Ports Authority: <http://www.gaports.com/Media/Publications/GatewayToTheWorld/SavannahHarborExpansionProject.aspx>
- GAPorts. (2015d, October). *Port of Brunswick*. Retrieved October 2015, from Georgia Ports Authority: <http://www.gaports.com/PortofBrunswick.aspx>

- GASHPO. (2009). *Rosenwald Schools in Georgia, 1912-1937*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources.
- GASWCC. (2015). *Title 12 - Conservation and Natural Resources: Chapter 7 - Control of Soil Erosion and Sedimentation*. Retrieved June 2017, from Georgia Soil and Water Conservation Commission:  
[https://gaswcc.georgia.gov/sites/gaswcc.georgia.gov/files/related\\_files/document/OCGA\\_June\\_2016.pdf](https://gaswcc.georgia.gov/sites/gaswcc.georgia.gov/files/related_files/document/OCGA_June_2016.pdf)
- GAWRD. (2016). *Georgia Hunting Season and Regulations*. Retrieved July 20, 2016, from eRegulations: <http://www.eregulations.com/georgia/hunting/2015-16-season-dates-limits/>
- Gehring, J., Kerlinger, P., & Manville., A. M. (2011). The role of tower height and guy wires on avian collisions with communication towers. *The Journal of Wildlife Management*, 75, 848-855. Retrieved from <http://onlinelibrary.wiley.com/doi/10.1002/jwmg.99/abstract>
- GEMA. (2011). Elected Officials Communications Forum. *GEMA Elected Officials Communications Forum* (p. 17). GEMA.
- GEMA. (2014). *2014 State of Georgia Hazard Mitigation Strategy*. Retrieved October 23, 2015, from  
[http://www.gema.ga.gov/Mitigation/Resource%20Document%20Library/2014%20GHM\\_S.pdf](http://www.gema.ga.gov/Mitigation/Resource%20Document%20Library/2014%20GHM_S.pdf)
- Georgia Conservancy. (2015). *Rising Tide*. Retrieved from  
<http://www.georgiaconservancy.org/coast/sea-level-rise.html>
- Georgia General Assembly. (2006, March). *Senate Bill 646*. Retrieved October 2015, from  
<http://www.legis.ga.gov/legislation/en-US/display/20052006/SB/646>
- Georgia General Assembly. (2015). *LexisNexis State of Georgia Code, Title 6 - Aviation*. Retrieved October 2015, from <http://www.lexisnexis.com/hottopics/gacode/Default.asp>
- Georgia Government. (2015). *Georgia Aviation Authority, About Us*. Retrieved October 2015, from <http://gaa.georgia.gov/about-us>
- Georgia House of Representatives. (1995). *HB 204 - Environmental Justice Act of 1995; enact*. Retrieved October 2015, from  
<http://www.legis.ga.gov/Legislation/Archives/19951996/leg/fulltext/hb204.htm>
- Georgia House of Representatives. (1997). *HB 385 - Environmental Justice Act of 1997; enact*. Retrieved October 2015, from  
<http://www.legis.ga.gov/Legislation/Archives/19971998/leg/fulltext/hb385.htm>
- Georgia River Network Water Trails Website. (2015). *More Permanent Protection for your River*. Retrieved October 26, 2015, from  
<http://www.garivers.org/gwtc/conservation/conservation-stewardship/41-gwtc/uncategorized/312-georgia-federalstate-protection.html>
- Georgia.gov. (2015, October 26). *Georgia's Scenic Highways and Byways*. Retrieved October 26, 2015, from <http://georgia.gov/blog/2013-07-15/georgias-scenic-highways-and-byways>
- GeorgiaInfo. (2015). *Georgia State Fossil (Shark Tooth)*. Retrieved November 2015, from  
<http://georgiainfo.galileo.usg.edu/topics/government/article/georgia-state-symbols/georgia-state-fossil-shark-tooth>
- GFC. (2005a, October 22). *State Managed Forests*. Retrieved October 22, 2015, from  
<http://www.gfc.state.ga.us/forest-management/state-forest-management/state-managed-forests/>

- GFC. (2005b). *State Managed Forests*. Retrieved October 25, 2015, from <http://www.gfc.state.ga.us/forest-management/state-forest-management/state-managed-forests/>
- GFC. (2015, August). *Georgia Statewide Assessment of Forest Resources*. Retrieved from <http://www.gatrees.org/about-us/strategic-plan/GAStatewideAssessmentofForestResources.pdf>
- GPO. (2010, April 5). Title 40 Code of Federal Regulations Part 93.153. Retrieved July 20, 2015, from [http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93\\_1153&rgn=div8](http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8)
- GPO. (2015a). *Noxious-Weed Seeds Law & Legal Definition*. Retrieved July 20, 2016, from U.S. Government Publishing Office: <https://www.gpo.gov/fdsys/pkg/USCODE-2011-title7/pdf/USCODE-2011-title7-chap104.pdf>
- GPO. (2015b, June). *Electronic Code of Federal Regulations*. Retrieved June 2015, from U.S. Government Publishing Office: [http://www.ecfr.gov/cgi-bin/text-idx?SID=6095c0db6bb5edb10c850334725dae34&mc=true&tpl=/ecfrbrowse/Title36/36tab\\_02.tpl](http://www.ecfr.gov/cgi-bin/text-idx?SID=6095c0db6bb5edb10c850334725dae34&mc=true&tpl=/ecfrbrowse/Title36/36tab_02.tpl)
- Grigor'ev, I. (2003). Biological Effects of Mobile Phone Electromagnetic Field on Chick Embryo (Risk Assessment using the Mortality Rate). 541-3.
- GSA. (2016). *Governor's South Atlantic Alliance - Coast and Ocean Portal*. Retrieved July 20, 2016, from EFH-Habitat Areas of Particular Concern (HAPC): <http://gsaportal.org/explore/catalog#essential-fish-habitat-efh-links>
- GSG. (1911). *Geology of the Coastal Plain of Georgia*. Retrieved October 2015, from Geological Survey of Georgia: [https://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/B-26.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/B-26.pdf)
- Haag, W. G. (1961). The Archaic of the Lower Mississippi Valley. *American Antiquity*, 26(3), 317-323. Retrieved October 2015, from <http://www.jstor.org/stable/277398>
- Herrick, S. (1965). *A Subsurface Study of Pleistocene Deposits in Coastal Georgia*. Retrieved October 2015, from [https://epd.georgia.gov/sites/epd.georgia.gov/files/related\\_files/site\\_page/IC-31.pdf](https://epd.georgia.gov/sites/epd.georgia.gov/files/related_files/site_page/IC-31.pdf)
- Hill, D., Hockin, D., Price, D., Tucker, G., Morris, R., & Treweek, J. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology*, 34(2): 275-288.
- Historic American Buildings Survey. (1933). South Front - Savannah Cotton Exchange, 100 East Bay Street, Savannah, Chatham County, GA. *Library of Congress Prints and Photographs Online Collection*. Savannah, Georgia: Library of Congress. Retrieved October 2015, from <http://www.loc.gov/resource/hhh.ga0141.photos/?sp=1>
- Historic American Buildings Survey. (1979). *Index to Photographs*. Retrieved October 2015, from <https://cdn.loc.gov/master/pnp/habshaer/ga/ga0200/ga0206/data/ga0206cap.pdf>
- Historic American Buildings Survey. (1980). *Index to Photographs*. Retrieved October 2015, from <https://cdn.loc.gov/master/pnp/habshaer/ga/ga0400/ga0413/data/ga0413cap.pdf>
- Historic American Engineering Record. (1968). 606 Lincoln Street (House), 606 Lincoln Street, La Grange, Troup County, GA. *Library of Congress Prints and Photographs Online Collection*. La Grange, Georgia: Library of Congress. Retrieved October 2015, from <http://www.loc.gov/resource/hhh.ga0821.photos>

- Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from [http://geology.isu.edu/wapi/EnvGeo/EG4\\_mass\\_wasting/EG\\_module\\_4.htm](http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm)
- IFC. (2007, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from <http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828>
- Institute of Maritime History. (2015, August). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from <http://www.maritimehistory.org/content/rainsford-island-archaeological-survey>
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Retrieved 2015, from Intergovernmental Panel on Climate Change: [www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4\\_syr.pdf](http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf)
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis*. Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/report/ar5/wg1/>
- ITU-T. (2012). *Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant*. International Telecommunication Union, Telecommunication Standardization Sector of ITU, Geneva.
- IWC. (2016). *Ship Strikes: Collisions between whales and vessels*. Retrieved August 4, 2016, from <https://iwc.int/ship-strikes>
- Jenkins, N. J., & Krause, R. A. (2009). A Woodland-Mississippian Interface in Alabama, CA. AD. 1075-1200: An Adaptive Radiation? *Southeastern Archaeology*, 28(2), 202-219. Retrieved October 2015, from <http://www.jstor.org/stable/40713519>
- Johnston, F. B. (1939). Baldwin-Massey House, Madison, Morgan County, Georgia. *Library of Congress Prints and Photographs Online Collection*. Madison, Georgia: Library of Congress. Retrieved October 2015, from <http://www.loc.gov/resource/csas.01091/>
- Kelly, A. R., & Hurst, V. J. (1956, October). Patination and Age Relationship in South Georgia Flint. *American Antiquity*, 22(2), 193-194. Retrieved October 2015, from <http://www.jstor.org/stable/276829>
- Knox, P. (2015). *Georgia's Climate is Peachy!* Retrieved from Georgia's Climate the Cocorah's State Climate Series: [http://www.cocorahs.org/Media/docs/ClimateSum\\_GA.pdf](http://www.cocorahs.org/Media/docs/ClimateSum_GA.pdf)
- Kottek, M. (2006). *World Map of the Köppen-Geiger Climate Classification*. Offenbach, Germany and Vienna, Austria: Gebrüder Borntraeger.
- Levitt, B., & Lai, H. (2010). *Biological Effects from Exposure to Electromagnetic Radiation Emitted by Cell Tower Base Stations and Other Antenna Arrays*. *Environ. Rev.* 18. doi:doi:10.1139/A10-018
- Long, D. (1920). *Soil Survey of Lowndes County Georgia*. Retrieved October 2015, from [http://www.nrcs.usda.gov/Internet/FSE\\_MANUSCRIPTS/georgia/lowndesGA1920/lowndesGA1920.pdf](http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/georgia/lowndesGA1920/lowndesGA1920.pdf)
- Long, L. T. (1999). *Emergency Manager's Guide to Earthquakes in Georgia*. Retrieved October 2015, from <http://quake.eas.gatech.edu/EMguide/EMguide.htm>
- Manville, A. (2007, February 2). Comments of the U.S. Fish and Wildlife Service Submitted Electronically to the FCC on 47 CFR Parts 1 and 17, WT Docket No. 03-187, FCC 06-164, Notice of Proposed Rulemaking, "Effects of Communication Towers on Migratory Birds".
- Manville, A. (2015, March 5). Recommendations for Additional Research and Funding to Assess Impacts of Non-Ionizing Radiation to Birds and Other Wildlife. Memorandum to Dr. J. McGlade, Science Advisor to United Nations Environment Program. 2.

- Manville, A. (2016a). Impacts to Birds and Bats Due to Collisions and Electrocutions from Some Tall Structures in the United States: Wires, Towers, Turbines and Solar Arrays — State of the Art in Addressing the Problems. In I. Angelici (Ed.), *Problematic Wildlife: A Cross-Disciplinary Approach* (pp. Chap 20, pp 415-442). Switzerland: Springer International Publishing. doi:10.1007/978-3-319-22246-2\_20
- Manville, A. (2016b, July 14). A Briefing Memo: What We Know, Can Infer, and Don't Yet Know About Impacts from Thermal and Non-Thermal Non-Ionizing Radiation to Birds and Other Wildlife — for public release. Peer-Reviewed Briefing Memo. p. 12.
- MARTA. (2014). *MARTA Annual Report*. Retrieved from <https://www.scribd.com/document/275207709/MARTA-Annual-Report-2014>
- Merriam Webster Dictionary. (2015a). *Airspace*. Retrieved June 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/airspace>
- Merriam Webster Dictionary. (2015b). *Sea Level*. Retrieved July 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/sea%20level>
- Michigan State University. (2016, October). *Title 27: Game and Fish - Chapter 3: Wildlife Generally - Article 5: Protection of Endangered Wildlife*. Retrieved June 2017, from Animal Law Legal Center home page: <https://www.animallaw.info/statute/ga-endangered-article-5-protection-endangered-wildlife>
- Miller, J. A. (1990). *Piedmont and Blue Ridge Aquifers, HA730-G*. Retrieved October 29, 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text8.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text8.html)
- Mitchell, R. (2014). Future climate and fire interactions in the South Eastern region of the United States. *Forest Ecology and Management*, 316-326.
- Moody, D. W., Carr, J., Chase, E. B., & Paulson, R. W. (1986). *National Water Summary 1986 - Hydrologic Events and Ground-Water Quality*. Retrieved April 5, 2015, from <http://pubs.er.usgs.gov/publication/wsp2325>
- NASA. (2013, July). Final Environmental Impact Statement: Sounding Rockets Program at Poker Flat Research Range. Wallops Island, VA. Retrieved July 1, 2016, from <http://netpublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf>
- NASAO. (2015). *Resources NASAO National Association of State Aviation Officials*. Retrieved July 2015, from NASAO National Association of State Aviation Officials: <http://www.nasao.org/>
- National Audubon Society. (2007). *Georgia important bird areas*. Retrieved from <http://netapp.audubon.org/IBA/State/US-GA>
- National Audubon Society. (2015a). *Important Bird Areas*. Retrieved from <http://netapp.audubon.org/iba/state/US-ga>
- National Audubon Society. (2015b). *Important bird areas - site profile 1863*. Retrieved from <http://netapp.audubon.org/iba/Site/1863>
- National Audubon Society. (2015c). *Important bird areas - site profile 1860*. Retrieved from <http://netapp.audubon.org/IBA/Site/1860>
- National League of Cities. (2007). *Sub-county, General-Purpose Governments by Population-Size Group and State*. (Census of Governments) Retrieved May 21, 2015, from <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-structures/number-of-municipal-governments-and-population-distribution>

- NatureServe. (2009, February 2). *Hamiota altilis* (Conrad, 1834), *Finelined Pocketbook*. Retrieved July 21, 2016, from <http://explorer.natureserve.org/servlet/NatureServe?searchName=Hamiota+altilis>
- NatureServe. (2015). *Conservation Status Assessment*. Retrieved from <http://www.natureserve.org/conservation-tools/conservation-status-assessment>
- NatureServe. (2017). *The NatureServe Network*. Retrieved June 2017, from <http://www.natureserve.org/natureserve-network>
- NCED. (2015). *State of Georgia and All Easements*. Retrieved October 29, 2015, from [http://conservationeasement.us/reports/easements?report\\_state=Georgia&report\\_type=All](http://conservationeasement.us/reports/easements?report_state=Georgia&report_type=All)
- NCMS. (2017). *State Wetlands Information Tool (SWIFT)*. Retrieved June 2017, from National Center for Manufacturing Sciences: <http://www.envcap.org/statetools/swift/swift2.cfm?st=GA>
- NCSL. (2015, February). *Federal and State Recognized Tribes*. Retrieved October 6, 2015, from <http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#fl>
- NECWA. (2007). *The Finback Whale (Balaenoptera physalus)*. Retrieved from <http://www.necwa.org/finback.html>
- New South Associates. (2010). *The Ranch House in Georgia: Guidelines for Evaluations*. Tucker: Georgia Transmission Corporation. Retrieved October 2015, from [http://issuu.com/georgiashpo/docs/ranch\\_house\\_guidelines?e=2602600/2599708](http://issuu.com/georgiashpo/docs/ranch_house_guidelines?e=2602600/2599708)
- NGE. (2013a). *Mammals*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/mammals>
- NGE. (2013b). *Right whales*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/right-whales>
- NGE. (2013c). *Sea turtles*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/sea-turtles>
- NGE. (2013d). *Freshwater mollusks*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/freshwater-mollusks>
- NGE. (2013e). *Shrimp*. Retrieved from <http://www.georgiaencyclopedia.org/articles/business-economy/shrimp>
- NGE. (2015a). *Birds*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/birds>
- NGE. (2015b). *Reptiles and amphibians*. Retrieved from <http://www.georgiaencyclopedia.org/articles/geography-environment/reptiles-and-amphibians>
- NGE. (2015c). *Geology of the Georgia coast*. Retrieved from <http://www.georgiaencyclopedia.org/articles/science-medicine/geology-georgia-coast>
- NHDES. (2014). *Geologic Mapping Program*. Retrieved August 2015, from <http://des.nh.gov/organization/commissioner/gsu/gmp/categories/overview.htm>
- Nicholls, B., & Racey, P. (2009, July 16). *The Aversive Effect of Electromagnetic Radiation on Foraging Bats — A Possible Means of Discouraging Bats from Approaching Wind Turbines*. (U. o. Raphaël Arlettaz, Ed.) doi:10.1371/journal.pone.0006246
- NIH. (2015, June). *What is TOXMAP?* Retrieved from <http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html>

- NIST. (2015, March). *Nationwide Public Safety Broadband Network Deployment: Network Parameter Sensitivity Analysis*. U.S. Department of Commerce. National Institute of Standards and Technology (NIST), Wireless Networks Division, Communications Technology Laboratory. Retrieved from <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8039.pdf>
- NOAA. (2010). *Essential fish habitat conservation mandate (Gulf of Mexico region)*. Retrieved from [http://sero.nmfs.noaa.gov/sustainable\\_fisheries/gulf\\_fisheries/generic/documents/pdfs/2013/gom\\_efh\\_guide\\_2010.pdf](http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/generic/documents/pdfs/2013/gom_efh_guide_2010.pdf)
- NOAA. (2012a, February 9). *State Coastal Zone Boundaries*. Retrieved from National Oceanic and Atmospheric Administration: <https://coast.noaa.gov/czm/media/StateCZBoundaries.pdf>
- NOAA. (2012b). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. Climate Program Office. Silver Spring: National Oceanic and Atmospheric Administration. Retrieved March 10, 2016, from [http://scenarios.globalchange.gov/sites/default/files/NOAA\\_SLR\\_r3\\_0.pdf](http://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf)
- NOAA. (2013). *Fin whale (Balaenoptera physalus)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm>
- NOAA. (2014a, January 29). *What is a slough?* Retrieved July 17, 2015, from <http://oceanservice.noaa.gov/facts/slough.html>
- NOAA. (2014b). *Hawksbill Turtle (Eretmochelys imbricata)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm>
- NOAA. (2014c). *Loggerhead Turtle (Caretta caretta)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm>
- NOAA. (2014d). *Shortnose Sturgeon (Acipenser brevirostrum)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm>
- NOAA. (2014e, February 3). *North and Central Georgia Winter Storm*. Retrieved October 15, 2015, from <http://www.srh.noaa.gov/ffc/?n=20140128winterstorm>
- NOAA. (2014f). *Atlanta Traffic During the Winter Storm*. Retrieved October 15, 2015, from <https://www.usnews.com/dims4/USNEWS/11301dc/2147483647/thumbnaill/766x511%3E/quality/85/?url=%2Fcmsmedia%2Fc7%2F58%2F3bb9ff32446ebc08c57fafc93190%2Fresizes%2F1500%2Fap721813729213.jpg>
- NOAA. (2015a). *Sapelo Island NERR*. Retrieved October 23, 2015, from <http://www.nerrs.noaa.gov/reserves/sapelo-island.html>
- NOAA. (2015b). *Flood Related Hazards*. Retrieved July 2015, from <http://www.floodsafety.noaa.gov/hazards.shtml>
- NOAA. (2015c). *Humpback Whale (Megaptera novaeangliae)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/mammals/whales/humpback-whale.html>
- NOAA. (2015d). *North Atlantic Right Whales (Eubalaena glacialis)*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/mammals/whales/north-atlantic-right-whale.html>
- NOAA. (2015e). *Critical Habitat for Endangered North Atlantic Right Whale*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2015-02-20/pdf/2015-03389.pdf>
- NOAA. (2015f). *Hawksbill Sea Turtle (Eretmochelys imbricata)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm>

- NOAA. (2015g). *Kemp's Ridley Turtle (*Lepidochelys kempii*)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/kempstridley.htm>
- NOAA. (2015h). *Leatherback Turtle (*Dermochelys coriacea*)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm>
- NOAA. (2015i). *National Oceanic and Atmospheric Administration*. Retrieved from National Centers of Environmental Information: <http://www.ncdc.noaa.gov/cag/time-series/us>
- NOAA. (2015j). *National Oceanic and Atmospheric Administration*. Retrieved from Data Tools: 1981 - 2010 Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>
- NOAA. (2015k). *General Coastline and Shoreline Mileage of the United States*. Retrieved from National Oceanic and Atmospheric Administration: <http://coast.noaa.gov/data/docs/states/shorelines.pdf>
- NOAA. (2016). *Humpback Whale (*Megaptera novaeangliae*)*. Retrieved July 15, 2016, from <http://www.nmfs.noaa.gov/pr/species/mammals/whales/humpback-whale.html#threats>
- NPS. (1983). *Archeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines*. Retrieved from [https://www.nps.gov/history/local-law/arch\\_stnds\\_0.htm](https://www.nps.gov/history/local-law/arch_stnds_0.htm)
- NPS. (1995, July 12). *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes*. Retrieved September 4, 2015, from National Park Service: <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm>
- NPS. (2000). *Geologic Glossary*. Retrieved August 2015, from <https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G>
- NPS. (2002). *How to Apply the National Register Criteria for Evaluation*. Retrieved from <https://www.nps.gov/nr/publications/bulletins/nrb15/>
- NPS. (2003, January 16). *History E-Library*. Retrieved October 20, 2015, from <http://www.nps.gov/parkhistory/hisnps/NPSHistory/nomenclature.html>
- NPS. (2004). *Rocky Mountain National Park*. Retrieved September 1, 2015, from [http://www.nps.gov/romo/learn/management/upload/romo\\_geo\\_overview.pdf](http://www.nps.gov/romo/learn/management/upload/romo_geo_overview.pdf)
- NPS. (2011a, May 19). *Connecting with Native Americans*. Retrieved April 12, 2015, from [http://www.nps.gov/history/tribes/Heritage\\_Areas.htm](http://www.nps.gov/history/tribes/Heritage_Areas.htm)
- NPS. (2011b, July 26). *Class I Area Locations*. Retrieved April 21, 2015, from <http://www.nature.nps.gov/air/maps/classiloc.cfm>
- NPS. (2012a, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from <http://nature.nps.gov/nnl/index.cfm>
- NPS. (2012b, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from <http://www.nps.gov/nts/legislation.html>
- NPS. (2012c, June 28). *National Natural Landmarks Program Georgia*. Retrieved October 25, 2015, from <http://www.nature.nps.gov/nnl/state.cfm?State=GA>
- NPS. (2012d, June 28). *Wassaw Island*. Retrieved October 25, 2015, from <http://www.nature.nps.gov/nnl/site.cfm?Site=WAIS-GA>
- NPS. (2013, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: <http://www.nature.nps.gov/geology/hazards/>
- NPS. (2014a, June 20). *Prohibition of Unmanned Aircraft in National Parks*. Retrieved June 2015, from <https://www.nps.gov/gaar/learn/news/prohibition-of-unmanned-aircraft-in-national-parks.htm>
- NPS. (2014b, 06 16). *National Park Service Science of Sound*. Retrieved 07 22, 2015, from <http://www.nature.nps.gov/sound/science.cfm>

- NPS. (2015a). *Geology of the Coastal Plain*. Retrieved April 2015, from [http://www.nps.gov/cue/geology/geo\\_coastalplain.htm](http://www.nps.gov/cue/geology/geo_coastalplain.htm)
- NPS. (2015b). *Georgia*. Retrieved October 29, 2015, from <http://www.nature.nps.gov/nnl/state.cfm?State=GA>
- NPS. (2015c). *Cumberland Island*. Retrieved October 2015, from <http://www.nps.gov/cuis/index.htm>
- NPS. (2015d). *National Park Service, Find A Park - Georgia*. Retrieved October 2015, from <http://www.nps.gov/state/nc/index.htm>
- NPS. (2015e, October). *Georgia*. Retrieved October 2015, from <https://www.nps.gov/state/ga/index.htm>
- NPS. (2015f). *National Heritage Areas: A Map of All the National Heritage Areas*. Retrieved May 2015, from National Park Service: <http://www.nps.gov/maps/full.html?mapId=01a03739-ab0c-40eb-bc3d-6791d3bb67fa>
- NPS. (2015g, October 5). *Gullah/Geechee Cultural Heritage Corridor*. Retrieved October 5, 2015, from <http://www.nps.gov/guge/learn/historyculture/index.htm>
- NPS. (2015h, April 27). *National Historic Landmarks Program*. Retrieved April 28, 2015, from <http://www.nps.gov/nhl/INDEX.htm>
- NPS. (2015i). *Listing of National Historic Landmarks by State: Georgia*. Retrieved October 20, 2015, from Recent & Selected NHL Designations: Georgia: <http://www.nps.gov/nhl/find/statelists/ga/GA.pdf>
- NPS. (2015j, February 18). *National Historic Landmarks Program*. Retrieved May 2016, from <https://www.nps.gov/nhl/>
- NPS. (2015k, October 20). *Cumberland Island National Seashore Photo Gallery*. Retrieved October 20, 2015, from <http://www.nps.gov/media/photo/gallery.htm?maxrows=20&id=D2AAF298%2D1DD8%2DB71C%2D07FC918B994C636F&showrawlisting=false&tagid=0&startrow=21>
- NPS. (2015l). *Wilderness*. Retrieved September 2015, from <http://wilderness.nps.gov/faqnew.cfm>
- NPS. (2015m). *Southeast Archaeological Center*. Retrieved October 2015, from <http://www.nps.gov/SEAC/hnc/outline/01-setting/index.htm>
- NPS. (2015n). *Southeast Archeological Center*. Retrieved September 2015, from <http://www.nps.gov/seac/hnc/outline/03-archaic/index.htm>
- NPS. (2015o, July). *National Register of Historic Places Program: Research*. Retrieved October 2015, from National Register of Historical Places: <http://www.nps.gov/nr/research/>
- NPS. (2015p, August 3). *National Park Service*. Retrieved 8 7, 2015, from Connecticut: <http://www.nps.gov/state/ct/index.htm>
- NPS. (2016a, June). *National Historic Landmarks Program*. Retrieved from <https://www.nps.gov/nhl/learn/intro.htm>
- NPS. (2016b). *National Register of Historic Places Program: Fundamentals*. Retrieved September 23, 2015, from [http://www.nps.gov/nr/national\\_register\\_fundamentals.htm](http://www.nps.gov/nr/national_register_fundamentals.htm)
- NPS. (2016c). *Southeast Archeological Center, Southeastern Prehistory*. Retrieved from National Park Service: <https://www.nps.gov/seac/hnc/outline/04-woodland/>
- NPS. (2017). *National Natural Landmarks*. Retrieved June 2017, from U.S. National Park Service: <https://www.nps.gov/subjects/nlandmarks/site.htm?Site=OKSW-GA>
- NRCS. (1996a). *Soil Quality Resource Concerns: Soil Erosion*. Retrieved September 2015, from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_051278.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051278.pdf)

- NRCS. (1996b). *Soil Quality Resource Concerns: Compaction*. Retrieved September 2015, from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_051594.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051594.pdf)
- NRCS. (1999). *Soil Taxonomy A Basic System of Soil Classification for Making and Interpreting Soil Surveys*. Retrieved from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_051232.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf)
- NRCS. (2000, March). *Soil Quality - Urban Technical Note No. 1*. Retrieved from Erosion and Sedimentation on Construction Sites: [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_053285.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf)
- NRCS. (2003). *Soil Compaction: Detection, Prevention, and Alleviation*. Retrieved September 2015, from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_053258.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053258.pdf)
- NRCS. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Retrieved May 2015, from Major Land Resource Area: [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_051845.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf)
- NRCS. (2009). *Protecting pollinators*. Retrieved from [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/newsroom/photos/?cid=nrcs144p2\\_057907](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/mt/newsroom/photos/?cid=nrcs144p2_057907)
- NRCS. (2015a). *What is Soil?* Retrieved June 2015, from Soil Education: [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2\\_054280](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054280)
- NRCS. (2015b). *Twelve Orders of Soil Taxonomy*. Retrieved August 2015, from Soils: [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2\\_053588](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053588)
- NRCS. (2015c). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved July 2015, from [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs143\\_010785.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf)
- NRCS. (2015d). *STATSGO2 Database*. Retrieved June 2015, from [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2\\_053629](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629)
- NRCS. (2015e). *Hydric Soils -- Introduction*. Retrieved June 2015, from [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2\\_053961](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961)
- NRCS. (2015f). *Erosion*. Retrieved September 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/>
- NRCS. (2015g). *Georgia Soil Survey 130B - Southern Blue Ridge*. Retrieved October 2015, from [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ga/soils/surveys/?cid=nrcs144p2\\_021881](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ga/soils/surveys/?cid=nrcs144p2_021881)
- NTFI. (2005). *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives: A Guide for Public Officials*. U.S. Department of Justice, Office of Justice Programs, National Institute of Justice. National Task Force on Interoperability (NTFI). Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/204348.pdf>
- NTIA. (2005, October). *Interference Protection Criteria Phase 1 - Compilation from Existing Sources 2005*. Retrieved from [https://www.ntia.doc.gov/files/ntia/publications/ipc\\_phase\\_1\\_report.pdf](https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf)
- NTIA. (2014). *Download Data*. Retrieved from National Broadband Map: <http://www.broadbandmap.gov/data-download>
- NWF. (2015). *Ecoregions*. Retrieved from <http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx>

- NWS. (2006). *JetStream Max: Addition Köppen-Geiger Climate Subdivisions*. Retrieved June 2017, from National Weather Service: National Oceanic and Atmospheric Administration: [http://www.srh.noaa.gov/jetstream//global/climate\\_max.htm](http://www.srh.noaa.gov/jetstream//global/climate_max.htm)
- NWS. (2009, June 25). *National Weather Service - Glossary*. Retrieved from National Oceanic and Atmospheric Administration: <http://w1.weather.gov/glossary/index.php?letter=c>
- NWS. (2011, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: [http://www.srh.noaa.gov/jetstream//global/climate\\_max.htm](http://www.srh.noaa.gov/jetstream//global/climate_max.htm)
- NWS. (2015a). *Flooding in Georgia*. Retrieved from <http://www.floodsafety.noaa.gov/states/ga-flood.shtml>
- NWS. (2015b). *Georgia Severe Weather Preparedness Week*. Retrieved from National Oceanic and Atmospheric Administration: [http://www.srh.noaa.gov/ffc/?n=swaw\\_thunder](http://www.srh.noaa.gov/ffc/?n=swaw_thunder)
- NWS. (2015c, June 10). *Office of Climate, Water, and Weather Services*. Retrieved October 15, 2015, from 2014 Summary of Hazardous Weather Fatalities, Injuries, and Damage by State: <http://www.nws.noaa.gov/om/hazstats/state14.pdf>
- NWSRS. (2015). *Chattooga River, Georgia, N. Carolina, S. Carolina*. Retrieved October 23, 2015, from <http://www.rivers.gov/rivers/chattooga.php>
- OECD. (2017). *Glossary of Statistical Terms: Recreational Land*. Retrieved June 2017, from Organisation for Economic Cooperation and Development: <https://stats.oecd.org/glossary/detail.asp?ID=2256>
- Olcott, P. G. (1995a). *Carbonate-Rock Aquifers, HA 730-M*. Retrieved May 5, 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_m/M-text4.html](http://pubs.usgs.gov/ha/ha730/ch_m/M-text4.html)
- Olcott, P. G. (1995b). *Sandstone Aquifers, HA-730-M*. Retrieved May 5, 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_m/M-text5.html](http://pubs.usgs.gov/ha/ha730/ch_m/M-text5.html)
- Oregon Department of Geology. (2015). *Earthquake Hazards in the Pacific Northwest*. Retrieved March 2015, from <http://www.oregongeology.org/sub/earthquakes/EQs.htm>
- OSHA. (2002). *Occupational Safety & Health Administration We Can Help*. Retrieved from Hearing Conservation: <https://www.osha.gov/Publications/OSHA3074/osha3074.html>
- OSHA. (2003). *Fact Sheets on Natural Disaster Recovery: Flood Cleanup*. Retrieved December 2013, from [https://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/Bulletin2.pdf](https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin2.pdf)
- OSHA. (2015). *Communication Towers*. Retrieved from <https://www.osha.gov/doc/topics/communicationtower/index.html>
- OSHA. (2016a). *OSHA Technical Manual: Noise*. Retrieved May 2016, from Section III: Chapter 5: [https://www.osha.gov/dts/osta/otm/new\\_noise/](https://www.osha.gov/dts/osta/otm/new_noise/)
- OSHA. (2016b, March 28). *Regulations (Standards - 29 CFR)*. Retrieved from Occupational Safety & Health Administration: [https://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=9867](https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867)
- OSHA. (2016c). *Restoring Communications Systems*. Retrieved February 16, 2016, from Infrastructure Repair and Restoration: <https://www.osha.gov/SLTC/etools/hurricane/communications.html>
- OSHA. (2016d, May 29). *Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring*. Retrieved from [https://www.osha.gov/dts/osta/otm/otm\\_v/otm\\_v\\_2.html](https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html)
- OSHA. (2016e). *Recommended Practices for Safety and Health Programs*. (S. L. OSHA Directorate of Technical Support and Emergency Management, & U. Salt Lake City,

- Editors) Retrieved June 2017, from U.S. Department of Labor: Occupational Safety and Health Administration: <https://www.osha.gov/shpguidelines/index.html>
- Page, S. D. (2012, October 15). Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit. Retrieved April 21, 2015, from <https://www.epa.gov/nsr/timely-processing-prevention-significant-deterioration-psd-permits-when-epa-or-psd-delegated-air>
- Panagopoulos, D., & Margaritis, L. (2008). Mobile Telephony Radiation Effects on Living Organisms. In .. H. Buress (Ed.), *Mobile Telephones* (pp. 107-149). Nova Science Publishers, Inc.
- Pauketat, T. R. (2012). *The Oxford Handbook of North American Archaeology*. New York, New York: Oxford University Press, Inc.
- Pichardo, M. (2005). Overview of Paleoindian Taxonomy and Migration Hypotheses. *Anthropologischer Anzeiger*, 63(3), 307-334. Retrieved October 2015, from <http://www.jstor.org/stable/29542674>
- Pluckhahn, T. J. (2010, December). Household Archaeology in the Southeastern United States: History, Trends, and Challenges. Retrieved October 2015, from <http://www.jstor.org/stable/23018401>
- Project25.org. (2015a, August 28). *P25 Phase 2 TDMA System in Service June 2015*. Retrieved August 28, 2015, from [http://www.project25.org/images/stories/ptig/docs/P25\\_phase\\_2\\_tdma\\_systems\\_updated\\_June\\_2015.pdf](http://www.project25.org/images/stories/ptig/docs/P25_phase_2_tdma_systems_updated_June_2015.pdf)
- Project25.org. (2015b, August 28). *P25 Phase1 FDMA System in Service (June 2015)*. Retrieved August 28, 2015, from [http://www.project25.org/images/stories/ptig/docs/P25\\_phase\\_1\\_fdma\\_systems\\_rev\\_2\\_u\\_pdate\\_June\\_2015.pdf](http://www.project25.org/images/stories/ptig/docs/P25_phase_1_fdma_systems_rev_2_u_pdate_June_2015.pdf)
- ProximityOne. (2015). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- PSC. (2015a, October). *An Introduction to Your Georgia Public Service Commission*. Retrieved October 2015, from Georgia Public Service Commission: <http://www.psc.state.ga.us/pscinfo/pscintro.asp#regulated>
- PSC. (2015b, October). *Electric*. Retrieved October 2015, from Georgia Public Service Commission: <http://www.psc.state.ga.us/electric/electric.asp>
- PSCR. (2015). *Location-Based Services R&D Roadmap*. U.S. Department of Commerce, National Institute of Standards and Technology (NIST), Public Safety Communications Research (PSCR). Retrieved from <http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1883.pdf>
- Purdue University. (2015). *Hydrologic Soil Groups*. Retrieved June 2015, from <https://engineering.purdue.edu/mapserve/LTHIA7/documentation/hsg.html>
- Purdue University Consumer Horticulture. (2006). *What is Loam?* Retrieved May 19, 2016, from <https://hort.purdue.edu/ext/loam.html>
- QAB. (1968). *Excerpts from Mineral Resources of the Appalachian Region*. Retrieved June 2017, from Quarries and Beyond: [http://quarriesandbeyond.org/articles\\_and\\_books/min\\_res\\_appalachian\\_region/tc\\_intro.html](http://quarriesandbeyond.org/articles_and_books/min_res_appalachian_region/tc_intro.html)

- Radbruch-Hall, D., Colton, R., Davies, W., Lucchitta, I., Skipp, B., & Varnes, D. (1982). *Landslide Overview Map of the Conterminous United States*. Retrieved October 2015, from <http://pubs.usgs.gov/pp/pp1183/pp1183.html>
- RadioReference.com. (2015a, September 23). *Georgia State Patrol Radio Reference*. Retrieved September 23, 2015, from <https://www.radioreference.com/apps/db/?aid=816>
- RadioReference.com. (2015b, September 24). *GA Common/Shared*. Retrieved September 24, 2015, from <http://www.radioreference.com/apps/db/?aid=2347>
- RadioReference.com. (2015c, September 23). *GA Medical Helicopters RadioReference*. Retrieved September 23, 2015, from <https://www.radioreference.com/apps/db/?aid=2837>
- RadioReference.com. (2015d, September 24). *Richmond County (GA) RadioReference*. Retrieved September 24, 2015, from <http://www.radioreference.com/apps/db/?ctid=503>
- Ray & Associates. (2016). *Public Elementary and Secondary Schools in Georgia, 1868-1971*. Atlanta: Historic Preservation Division, Georgia Department of Natural Resources.
- Regulations.gov. (2016, October 11). *Comment on FIRSTNET-2016-0003-0001*. Retrieved from <https://www.regulations.gov/document?D=FIRSTNET-2016-0003-0026>
- Reitz, E. J. (1988). Evidence for Coastal Adaptations in Georgia and South Carolina. *Archaeology of Eastern North America*, 16(1), 137-158. Retrieved October 2015, from <http://www.jstor.org/stable/40914298>
- Rochester Academy of Science. (2015). *New York Fossils*. Retrieved March 2015, from The Rochester Academy of Science Fossil Section: <http://www.rasny.org/fossil/NYFossils.htm>
- Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils*. Retrieved March 23, 2015, from [http://web.mst.edu/~rogersda/expansive\\_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf](http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf)
- Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved 6 10, 2015, from [http://www.sacramento.aero/scas/environment/noise/noise\\_101/](http://www.sacramento.aero/scas/environment/noise/noise_101/)
- SCEC. (2015). *State Climate Extremes Committee*. (N. O. Administration, Producer) Retrieved 2015, from National Climatic Data Center: <http://www.ncdc.noaa.gov/extremes/scec/records>
- Schueller, & Peterson. (2010). *Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia*. Retrieved from <http://www.tandfonline.com/doi/abs/10.1577/T09-127.1?journalCode=utaf20>
- Sherwood, S. C., Driskel, B. N., Randall, A. R., & Meeks, S. C. (2004). Chronology and Stratigraphy at Dust Cave, Alabama. *American Antiquity*, 69(3), 533-554. Retrieved October 2015, from <http://www.jstor.org/stable/4128405>
- Smithsonian Institution. (2016). *Glossary -- Courtesy of the Department of Paleobiology, National Museum of Natural History, Washington, DC*. Retrieved May 2016, from <http://paleobiology.si.edu/geotime/main/glossary.html#T>
- SOS. (2015, October). *Board of Water and Wastewater Treatment Plant Operators*. Retrieved October 2015, from Secretary of State: <http://sos.ga.gov/index.php/licensing/plb/54>
- Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene Jr., C. R., . . . Tyack, P. L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals*, 121.

- State of Georgia. (2012a). *State of Georgia Satewide Communication Interoperability Plan*. Sate of Georgia. Retrieved from [http://www.gema.ga.gov/Plan%20Library/Statewide%20Communication%20Interoperability%20Plan%20\(SCIP\)%20-%20Public%20\(2012\).pdf](http://www.gema.ga.gov/Plan%20Library/Statewide%20Communication%20Interoperability%20Plan%20(SCIP)%20-%20Public%20(2012).pdf)
- State of Georgia. (2012b). *GAinterop:Executive Summary-- Georgia SCIP*. Retrieved September 24, 2015, from [http://www.gainterop.com/GaInterop\\_History.pdf](http://www.gainterop.com/GaInterop_History.pdf)
- State of Georgia. (2012c). *Greenhouse Gas Emissions Inventory for the State of Georgia*. Department of Natural Resources. Retrieved 10 23, 2015, from [https://epd.georgia.gov/air/sites/epd.georgia.gov.air/files/related\\_files/document/ghg\\_gaiinventory2012.pdf](https://epd.georgia.gov/air/sites/epd.georgia.gov.air/files/related_files/document/ghg_gaiinventory2012.pdf)
- State of Georgia. (2015). *Georgia Facts and Symbols*. Retrieved September 16, 2015, from <http://georgia.gov/georgia-facts-and-symbols>
- Sullivan, B., & Georgia Historical Society. (2003). *Georgia: A State History*. Charleston: Arcadia Publishing.
- The Paleontology Portal. (2015). *Georgia, US*. Retrieved November 4, 2015, from Time & Space: [http://paleoportal.org/index.php?globalnav=time\\_space&sectionnav=state&name=Georgia](http://paleoportal.org/index.php?globalnav=time_space&sectionnav=state&name=Georgia)
- Thompson, V. D. (2007). Articulating Activity Areas and Formation Processes at the Sapelo Island Shell Ring Complex. *Southeastern Archaeology*, 26(1), 91-107. Retrieved October 2015, from <http://www.jstor.org/stable/40713419>
- Thompson, W. (2015). *Surficial Geology Handbook for Southern Maine*. Retrieved July 2015, from [http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial\\_geology\\_handbook\\_for\\_southern\\_maine.pdf](http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial_geology_handbook_for_southern_maine.pdf)
- TVA. (2015). *TVA in Georgia*. Retrieved October 25, 2015, from <https://www.tva.com/About-TVA/TVA-in-Georgia>
- U.S. Bureau of Justice Statistics. (2011, July 26). *Census of State and Local Law Enforcement Agencies*. Retrieved from <http://www.bjs.gov/index.cfm?ty=pbdetail&iid=2216>
- U.S. Census Bureau. (2006a). *Government Finance and Employment Classification Manual. 2006\_classification\_manual*. Retrieved July 2015, from [http://www2.census.gov/govs/pubs/classification/2006\\_classification\\_manual.pdf](http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf)
- U.S. Census Bureau. (2006b). *Government Finance and Employment Classification Manual. 2006\_classification\_manual*. Retrieved July 2015, from [http://www2.census.gov/govs/pubs/classification/2006\\_classification\\_manual.pdf](http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf)
- U.S. Census Bureau. (2012). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas first sorted by state FIPS code, then sorted by UACE code. Retrieved June 2015, from [http://www2.census.gov/geo/docs/reference/ua/ua\\_st\\_list\\_all.xls](http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls)
- U.S. Census Bureau. (2013a, September). *Individual State Descriptions: 2012*. Retrieved from <http://www2.census.gov/govs/cog/2012isd.pdf>
- U.S. Census Bureau. (2013b). *2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April, July 2015, from

- [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_5YR\\_DP03&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table)
- U.S. Census Bureau. (2013c). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions*. 2013\_ACSSubjectDefinitions. Retrieved April 2015, from [http://www2.census.gov/programs-surveys/acs/tech\\_docs/subject\\_definitions/2013\\_ACSSubjectDefinitions.pdf](http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf)
- U.S. Census Bureau. (2013d). *American Community Survey, 2013 1-Year Estimates, Table DP04, Selected housing characteristics*. (Obtained via Census Bureau online American FactFinder tool) Retrieved April 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_DP04&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP04&prodType=table)
- U.S. Census Bureau. (2013e). *American Community Survey, 2009-2013 5-year Estimates, Table DP04, Selected housing characteristics*. Retrieved April, July 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_5YR\\_DP04&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP04&prodType=table)
- U.S. Census Bureau. (2013f). *American Community Survey, 2013 1-Year Estimates, Table DP05, Demographic and Housing Estimates*. Retrieved August 31, 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_DP05&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP05&prodType=table)
- U.S. Census Bureau. (2013g). *American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months*. Retrieved August 31, 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_S1701&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1701&prodType=table)
- U.S. Census Bureau. (2015a, May 28). *U.S. Census Bureau*. Retrieved May 21, 2015, from State and County Quickfacts: <http://quickfacts.census.gov/qfd/states/13000.html>
- U.S. Census Bureau. (2015b). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014*. Washington, D.C.: US. Census Bureau, Population Division.
- U.S. Census Bureau. (2015c, March 11). *Foreign Trade*. Retrieved March 2015, from United States Census Bureau: <http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/index.html>
- U.S. Census Bureau. (2015d). *2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density*. (Obtained via Census Bureau online American FactFinder tool) Retrieved June 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC\\_10\\_SF1\\_GCTPH1.US01PR&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_GCTPH1.US01PR&prodType=table)
- U.S. Census Bureau. (2015e). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Other Census Urban Area Information - Maps, Shapefiles & References. Retrieved June 2015, from <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2015f). *Population Estimates Program, 2010-2014 Data*. Retrieved March 2015, from <http://www.census.gov/popest/data/national/totals/2014/NST-EST2014-alldata.html>
- U.S. Census Bureau. (2015g). *Resident Population of the 50 States, the District of Columbia, and Puerto Rico: Census 2000*. File tab02.xls. Retrieved March 2015, from <https://www.census.gov/population/www/cen2000/maps/resp.html>

- U.S. Census Bureau. (2015h). *American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race*. (Obtained via Census Bureau online DataFerrett tool) Retrieved April 2015, from <http://dataferrett.census.gov/>
- U.S. Census Bureau. (2015i). Census 2000 Summary File 1 (SF 1), Table P001, Total Population. Retrieved July 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>
- U.S. Census Bureau. (2015j). American Community Survey, 2009-2013 5-Year Estimates, Table DP05, Demographic and Housing Estimates. Retrieved August 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- U.S. Census Bureau. (2015k). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions*. 2013\_ACSSubjectDefinitions. Retrieved April 2015, from [http://www2.census.gov/programs-surveys/acs/tech\\_docs/subject\\_definitions/2013\\_ACSSubjectDefinitions.pdf](http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf)
- U.S. Census Bureau. (2015l). *Small Area Income and Poverty Estimates (SAIPE), 2013*. Retrieved March 2015, from <http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html>
- U.S. Census Bureau. (2015m). American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics. Retrieved April 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_DP02&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table)
- U.S. Census Bureau. (2015n). American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars). Retrieved April 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_S1902&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table)
- U.S. Census Bureau. (2015o). American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics. Retrieved June 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_13\\_1YR\\_DP03&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table)
- U.S. Census Bureau. (2015p). 2012 Census of Governments: Finance – Surveys of State and Local Government Finances, Table LGF001. Retrieved June 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG\\_2012\\_LGF001&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG_2012_LGF001&prodType=table)
- U.S. Census Bureau. (2015q). American Community Survey, 2012 1-Year Estimates, Table B01003: Total Population. Retrieved June 2015, from [http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS\\_12\\_1YR\\_B01003&prodType=table](http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B01003&prodType=table)
- U.S. Census Bureau. (2015r). American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015s). American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015t). American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months. Retrieved May 2015, from <http://dataferrett.census.gov>

- U.S. Census Bureau. (2016). *American Community Survey (ACS)*. Retrieved March 2016, from <http://www.census.gov/programs-surveys/acs/>
- U.S. Census Bureau. (2017). *Georgia Quickfacts from the U.S. Census Bureau*. Retrieved June 2017, from <https://www.census.gov/quickfacts/table/PST045216/13,00>
- U.S. Fire Administration. (2015, June 11). *National Fire Department Census*. Retrieved from <http://apps.usfa.fema.gov/census-download/main/download>
- U.S. Harbors. (2015, December). *U.S. Harbors*. Retrieved December 2015, from <http://usharbors.com>
- University of California Hastings. (2010). *Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases*. Retrieved October 2015, from <http://gov.uchastings.edu/public-law/docs/ejreport-fourthedition.pdf>
- University of California Museum of Paleontology. (2006). *Introduction to the Urochordata*. Retrieved July 15, 2016, from <http://www.ucmp.berkeley.edu/chordata/urochordata.html>
- University of California Museum of Paleontology. (2011, May). *Geologic Time Scale*. Retrieved June 2016, from <http://www.ucmp.berkeley.edu/help/timeform.php>
- University of Delaware. (2016). *Glossary*. Retrieved February 6, 2016, from <http://www.udel.edu/FREC/spatlab/oldpix/nrcssoilde/Descriptions/glossary.doc>
- University of Georgia. (1998). *Bee conservation in the southeast*. Retrieved from <http://www.ent.uga.edu/bees/BeeConservationintheSoutheastHoneyBeeProgramCAESEntomologyUGA.html#top>
- University of Georgia. (2015a). *Known species*. Retrieved from [http://marex.uga.edu/known\\_species/](http://marex.uga.edu/known_species/)
- University of Georgia. (2015b). *Sea Level Rise in Georgia*. Retrieved from [http://georgiaseagrant.uga.edu/article/sea\\_level\\_rise\\_in\\_georgia/](http://georgiaseagrant.uga.edu/article/sea_level_rise_in_georgia/)
- University of Minnesota. (2001). *Soils and Landscapes of Minnesota*. Retrieved July 2015, from <http://www.extension.umn.edu/agriculture/tillage/soils-and-landscapes-of-minnesota/>
- USACE. (2012). *National Wetland Plant List Indicator Rating Definitions obligate*. Retrieved from <http://www.fws.gov/wetlands/documents/National-Wetland-Plant-List-Indicator-Rating-Definitions.pdf>
- USACE. (2015a, October). *Savannah Harbor Expansion Project*. Retrieved October 2015, from US Army Corps of Engineers: <http://www.sas.usace.army.mil/Missions/CivilWorks/SavannahHarborExpansion.aspx>
- USACE. (2015b, October). *Savannah Harbor Entrance Channel: Nearshore Placement of Dredged Material Study*. Retrieved October 2015, from US Army Corps of Engineers: <http://chl.erdc.usace.army.mil/chl.aspx?p=s&a=Projects;194>
- USACE. (2015c, August). *Corps Lakes Gateway*. Retrieved October 25, 2015, from <http://corpslakes.usace.army.mil/visitors/states.cfm?state=GA>
- USACE. (2017). *Civil Works Recreation*. Retrieved June 2017, from U.S. Army Corps of Engineers: <http://www.usace.army.mil/Missions/Civil-Works/Recreation/>
- USCG. (2014). *National Response Center (2014 Reports)*. Retrieved October 15, 2015, from <http://nrc.uscg.mil/FOIAFiles/CY14.xlsx> via <http://nrc.uscg.mil/>
- USCG. (2015, December). *National Response Center (2015 Reports)*. Retrieved March 24, 2016, from <http://nrc.uscg.mil/FOIAFiles/CY15.xlsx> via <http://nrc.uscg.mil/>
- USDA. (2012, October 22). *Table 8. Land: 2012 and 2007*. Retrieved October 22, 2015, from [http://www.agcensus.usda.gov/Publications/2012?Full Report/Volume 1, Chapter 1 State Level/Georgia/](http://www.agcensus.usda.gov/Publications/2012?Full%20Report/Volume%201,%20Chapter%201%20State%20Level/Georgia/)

- USDA. (2015a). *Ecoregions of the United States*. Retrieved from <http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/>
- USDA. (2015b). *Plant Pests and Diseases*. Retrieved from [https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/planthealth?1dmy&urile=wcm%3Apath%3a%2FAPHIS\\_Content\\_Library%2FSA\\_Our\\_Focus%2FSA\\_Plant\\_Health%2FA\\_Domestic\\_Pests\\_And\\_Diseases](https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/planthealth?1dmy&urile=wcm%3Apath%3a%2FAPHIS_Content_Library%2FSA_Our_Focus%2FSA_Plant_Health%2FA_Domestic_Pests_And_Diseases)
- USDA. (2015c, April 9). *Major Uses of Land in the United States, 2007*. Retrieved October 26, 2015, from <http://www.ers.usda.gov/data-products/major-land-uses/maps-and-state-rankings-of-major-land-uses.aspx>
- USDOC. (2013a, February). *Metropolitan Statistical Areas of Georgia*. Retrieved October 18, 2015, from U.S. Census Bureau: [http://www2.census.gov/geo/maps/metroarea/stcbsa\\_pg/Feb2013/cbsa2013\\_GA.pdf](http://www2.census.gov/geo/maps/metroarea/stcbsa_pg/Feb2013/cbsa2013_GA.pdf)
- USDOC. (2013b, February 21). *Department of Commerce Environmental Justice Strategy*. Retrieved July 2015, from [http://open.commerce.gov/sites/default/files/DOC\\_Environmental\\_Justice\\_Strategy.pdf](http://open.commerce.gov/sites/default/files/DOC_Environmental_Justice_Strategy.pdf)
- USDOJ. (2008). *Navajo Reservoir RMP/FEA Appendix E Noise*. Retrieved 07 22, 2015, from <https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf>
- USDOJ, Office of Surface Mining Reclamation and Enforcement. (2015a, December 2). *e-AMLIS Advanced Query*. Retrieved December 2, 2015, from <http://amlis.osmre.gov/QueryAdvanced.aspx>
- USDOJ, Office of Surface Mining Reclamation and Enforcement. (2015b, May 26). *Abandoned Mine Land Inventory System (e-AMLIS) State and Tribal Summary*. Retrieved September 26, 2015, from <http://amlis.osmre.gov/Summaries.aspx>
- USDOJ, Office of Surface Mining Reclamation and Enforcement. (2015c, October 23). *Mapping*. Retrieved October 23, 2015, from <http://amlis.osmre.gov/Map.aspx>
- USDOJ, Office of Surface Mining Reclamation and Enforcement. (2015d, May 26). *Mine Fires and Burning Refuse*. Retrieved from Mine Fires: <http://www.osmre.gov/programs/tdt/minesfires.shtm>
- USDOT. (2010). *Transit Asset and Management Practices, A National and International Review*. Retrieved October 18, 2015, from U.S. Department of Transportation, Federal Transit Administration: [https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/TAM\\_A\\_National\\_and\\_International\\_Review\\_-\\_6.10\\_FINAL\\_0.pdf](https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/TAM_A_National_and_International_Review_-_6.10_FINAL_0.pdf)
- USDOT. (2015a). *National Transportation Atlas Database*. Retrieved July 2015, from Bureau of Transportation Statistics National Transportation Atlas Database: [http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national\\_transportation\\_atlas\\_database/index.html](http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html)
- USDOT. (2015b). *National Transportation Atlas Database*. Retrieved 2015 August, from [http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national\\_transportation\\_atlas\\_database/index.html](http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html)
- USEPA. (1973, July 27). *Impact Characterization of Noise Including Implications of Identifying and Achieving Levels of Cumulative Noise Exposure*. Retrieved 08 05, 2015, from National Service Center for Environmental Publications (NSCEP): <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9101DPQN.TXT>

- USEPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Washington, D.C.: EPA. Retrieved from <https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockkey=2000L3LN.TXT>
- USEPA. (1979, March 19). Notification to Federal Land Manager Under Section 165(d) of the Clean Air Act. Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/fdlnmgr.pdf>
- USEPA. (1992a, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts*, Environmental Protection Agency. Retrieved April 21, 2015, from <http://www.epa.gov/region07/air/nsr/nsrmemos/class1.pdf>
- USEPA. (1992b, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts*, U.S. Environmental Protection Agency. (J. S. Seitz, Ed.) Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf>
- USEPA. (2004, April 15). *Inventory of U.S. Greenhouse Gas Emissions and Sinks: Glossary*. Retrieved July 16, 2015, from [http://ofmpub.epa.gov/sor\\_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&vocabName=Greenhouse%20Emissions%20Glossary&uid=1869718#formTop](http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&vocabName=Greenhouse%20Emissions%20Glossary&uid=1869718#formTop)
- USEPA. (2007, October). *Atlantic Steel*. Retrieved October 14, 2015, from <http://www3.epa.gov/epawaste/hazard/correctiveaction/pdfs/atlan11-07.pdf>
- USEPA. (2009). *National Lakes Assessment: A Collaborative Study of the Nation's Lakes*. Retrieved March 27, 2015, from [http://www.epa.gov/owow/LAKES/lakessurvey/pdf/nla\\_report\\_low\\_res.pdf](http://www.epa.gov/owow/LAKES/lakessurvey/pdf/nla_report_low_res.pdf)
- USEPA. (2010, March 24). Revisions to the General Conformity Regulations. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity/final-revisions-general-conformity-regulations>
- USEPA. (2011, December 12). *CERCLA Overview*. Retrieved from EPA Superfund: <http://www.epa.gov/superfund/policy/cercla.htm>
- USEPA. (2012a). *Water: Estuaries and Coastal Watersheds*. Retrieved April 5, 2015, from Basic Information about Estuaries: <http://water.epa.gov/type/oceb/nep/about.cfm>
- USEPA. (2012b, May). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from Visibility: <http://www3.epa.gov/airquality/visibility/class1.html>
- USEPA. (2012c). *Climate Change Indicators in the United States 2012*. Retrieved June 2017, from Environmental Protection Agency: <https://www.epa.gov/sites/production/files/2016-08/documents/climateindicators-full-2012.pdf>
- USEPA. (2012d). *Marine Debris Impacts*. Retrieved from <http://www.epa.gov/learn-issues/water-resources#our-waters>
- USEPA. (2013a, February 21). *EPA Terminology Services*. (U.S. Environmental Protection Agency) Retrieved July 28, 2015, from [http://iaspub.epa.gov/sor\\_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do](http://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do)
- USEPA. (2013b, March 29). *Sole Source Aquifers in the Southeast*. Retrieved September 25, 2013, from <http://www.epa.gov/region4/water/groundwater/r4ssa.html>
- USEPA. (2013c, August 13). *General Conformity*. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity>

- USEPA. (2013d). *Cleanups in my Community*. Retrieved October 2013, from <http://www2.epa.gov/cleanups/cleanups-my-community>
- USEPA. (2014a). *EPA Policy on Environmental Justice for*. Retrieved June 2017, from <https://www.epa.gov/sites/production/files/2015-02/documents/ej-indigenous-policy.pdf>
- USEPA. (2014b, October 21). *National Ambient Air Quality Standards (NAAQS)*. Retrieved April 20, 2015, from <http://www.epa.gov/air/criteria.html>
- USEPA. (2014c, October 28). *Who Has to Obtain a Title V Permit*. Retrieved April 20, 2015, from <https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit>
- USEPA. (2014d, October 28). *Title V Operating Permits*. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/permits/obtain.html>
- USEPA. (2014e). *National Greenhouse Gas Emissions Data*. Retrieved 5 5, 2014, from <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html>
- USEPA. (2015a, October). *Water Permitting 101*. Retrieved October 2015, from US Environmental Protection Agency: <http://water.epa.gov/polwaste/npdes/basics/upload/101pape.pdf>
- USEPA. (2015c, January). *Chesapeake Bay Glossary*. Retrieved July 15, 2015, from [http://ofmpub.epa.gov/sor\\_internet/registry/termreg/searchandretrieve/glossariesandkeyw ordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary](http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeyw ordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary)
- USEPA. (2015c, October 23). *Georgia Water Quality Assessment Report*. Retrieved October 23, 2015, from [http://ofmpub.epa.gov/tmdl\\_waters10/attains\\_state.control?p\\_state=GA](http://ofmpub.epa.gov/tmdl_waters10/attains_state.control?p_state=GA)
- USEPA. (2015d). *USEPA Terms Index*. Retrieved from [https://iaspub.epa.gov/sor\\_internet/registry/termreg/](https://iaspub.epa.gov/sor_internet/registry/termreg/)
- USEPA. (2015e). *Environmental Justice*. Retrieved July 2015, from <http://www.epa.gov/compliance/environmentaljustice/index.html>
- USEPA. (2015f). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from <http://www2.epa.gov/ejscreen>
- USEPA. (2015g, July 17). *Technology Transfer Network - Basic Information*. Retrieved July 17, 2015, from [http://cfpub.epa.gov/oarweb/mkb/basic\\_information.cfm](http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm)
- USEPA. (2015h, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: <http://www3.epa.gov/airquality/permjump.html>
- USEPA. (2015i, April 7). *Cleanups in my Community*. Retrieved October 14, 2015, from [http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73:::71:P71\\_WELSEARCH:GA|State|NE||true|true|true|true|true|-1|sites|N|basic](http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73:::71:P71_WELSEARCH:GA|State|NE||true|true|true|true|true|-1|sites|N|basic)
- USEPA. (2015j, October 8). *Cleanups in My Community List Results*. Retrieved October 14, 2015, from [http://ofmpub.epa.gov/apex/cimc/f?p=100:35:12997543350954:::35:P35\\_State\\_code,P35\\_ADV\\_QUERY:GA,\(\(SF\\_EI\\_HE\\_CODE%3D%2527N%2527\)\)](http://ofmpub.epa.gov/apex/cimc/f?p=100:35:12997543350954:::35:P35_State_code,P35_ADV_QUERY:GA,((SF_EI_HE_CODE%3D%2527N%2527)))
- USEPA. (2015k, September 18). *Envirofacts - PCS-ICIS*. Retrieved October 22, 2015, from <http://www3.epa.gov/enviro/facts/pcs-icis/search.html>
- USEPA. (2015l, October). *Envirofacts Search Results*. Retrieved October 2015, from [https://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac\\_search=primary\\_name&fac\\_value=telecommunication&fac\\_search\\_type=Containing&postal\\_code=&location\\_address=&add\\_search\\_type=Beginning+With&city\\_name=&county\\_name=&state\\_code=GA&TribalLand=0&TribeTy](https://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac_search=primary_name&fac_value=telecommunication&fac_search_type=Containing&postal_code=&location_address=&add_search_type=Beginning+With&city_name=&county_name=&state_code=GA&TribalLand=0&TribeTy)

- USEPA. (2015m, September 29). *Site Information for ARMSTRONG WORLD INDUSTRIES*. Retrieved October 15, 2015, from [http://cumulis.epa.gov/supercpad/cursites/dsp\\_ssppSiteData1.cfm?id=0410033#Why](http://cumulis.epa.gov/supercpad/cursites/dsp_ssppSiteData1.cfm?id=0410033#Why)
- USEPA. (2015n). *Watershed Assessment, Tracking & Environmental Results System*. Retrieved April 6, 2015, from Georgia Assessment Data for 2012: [https://ofmpub.epa.gov/waters10/attains\\_state.report\\_control?p\\_state=GA&p\\_cycle=2012&p\\_report\\_type=A](https://ofmpub.epa.gov/waters10/attains_state.report_control?p_state=GA&p_cycle=2012&p_report_type=A)
- USEPA. (2016a, August). *Glossary of Climate Change Terms*. Retrieved from Climate Change: <https://www3.epa.gov/climatechange/glossary.html>
- USEPA. (2016b, February 21). *Ecoregions of North America*. Retrieved from Western Ecology Division: [https://archive.epa.gov/wed/ecoregions/web/html/na\\_eco.html](https://archive.epa.gov/wed/ecoregions/web/html/na_eco.html)
- USEPA. (2016c, May 28). *Waste and Cleanup Risk Assessment Glossary*. Retrieved from Vocabulary Catalog: [https://ofmpub.epa.gov/sor\\_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Waste%20and%20Cleanup%20Risk%20Assess](https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Waste%20and%20Cleanup%20Risk%20Assess)
- USEPA. (2016d). *Environmental Justice*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/>
- USEPA. (2016e, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from <https://www.epa.gov/haps>
- USEPA. (2016f, May 19). *De Minimis Levels*. Retrieved from <https://www3.epa.gov/airquality/genconform/deminimis.html>
- USEPA. (2016g). *NAAQS Table: Criteria Air Pollutants*. Retrieved June 2017, from <https://www.epa.gov/criteria-air-pollutants/naaqs-table>
- USEPA. (2016h, September). *Ozone Designation and Classification Information*. Retrieved June 2017, from <https://www.epa.gov/green-book/ozone-designation-and-classification-information>
- USEPA. (2016i, October). *2013 TRI Analysis: State - Georgia*. Retrieved December 2, 2015, from [http://iaspub.epa.gov/triexplorer/tri\\_factsheet.factsheet\\_forstate?&pstate=GA&pyear=2013&pDataSet=TRIQ1](http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?&pstate=GA&pyear=2013&pDataSet=TRIQ1)
- USEPA. (2016j). *Grants and Programs*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/grants/index.html>
- USEPA. (2017a, February). *Why Are Wetlands Important?* Retrieved June 21, 2017, from Wetlands Protection and Restoration - U.S. Environmental Protection Agency: <https://www.epa.gov/wetlands/why-are-wetlands-important>
- USEPA. (2017b). *Overview of the Clean Air Act and Air Pollution*. Retrieved June 2017, from <https://www.epa.gov/clean-air-act-overview>
- USEPA. (2017c, February 13). *The Green Book Nonattainment Areas for Criteria Pollutants*. Retrieved June 2017, from <http://www.epa.gov/green-book/>
- USEPA. (2017d, April). *Clean Air Act Title IV - Noise Pollution*. Retrieved June 2017, from <https://www.epa.gov/clean-air-act-overview/clean-air-act-title-iv-noise-pollution>
- USFS. (2009a, Sept 30). *Chapter 90 Communiations Site Management*. Retrieved Nov 16, 2015, from Forest Service Handbook 2709.11 - Special Uses Handbook: [http://www.fs.fed.us/specialuses/documents/Comm\\_Use\\_Policy\\_2709.11\\_90.doc](http://www.fs.fed.us/specialuses/documents/Comm_Use_Policy_2709.11_90.doc)

- USFS. (2009b). *Soil-Disturbance Field Guide*. USDA. Retrieved from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFS. (2015a). *Chattahoochee-Oconee National Forest*. Retrieved October 2015, from <http://www.fs.usda.gov/main/conf/home>
- USFS. (2015b). *Chattahoochee-Oconee National Forest*. Retrieved October 25, 2015, from <http://www.fs.usda.gov/conf>
- USFS. (2015c, October). *Cohutta Wilderness Trailheads*. Retrieved October 29, 2015, from United States Department of Agriculture Forest Service: <http://www.fs.usda.gov/recarea/conf/recarea/?recid=10465>
- USFS. (2016). *Trail Safety*. Retrieved July 20, 2016, from Chattahoochee and Oconee National Forests: [http://www.fs.usda.gov/detail/conf/learning/safety-ethics/?cid=FSM9\\_029237](http://www.fs.usda.gov/detail/conf/learning/safety-ethics/?cid=FSM9_029237)
- USFWS. (1982). *Recovery plan for eastern indigo snake*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/820422.pdf](http://ecos.fws.gov/docs/recovery_plan/820422.pdf)
- USFWS. (1983). *Recovery plan for snail darter*. Retrieved from <http://pbadupws.nrc.gov/docs/ML1217/ML12173A447.pdf>
- USFWS. (1984a). *Recovery plan for hairy rattleweed*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/hairy%20rattleweed%20rp.pdf](http://ecos.fws.gov/docs/recovery_plan/hairy%20rattleweed%20rp.pdf)
- USFWS. (1984b). *Recovery plan for persistent trillium*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/840327.pdf](http://ecos.fws.gov/docs/recovery_plan/840327.pdf)
- USFWS. (1985, August). *Determination on amber darter and Conasauga logperch*. Retrieved from [http://ecos.fws.gov/docs/federal\\_register/fr995.pdf](http://ecos.fws.gov/docs/federal_register/fr995.pdf)
- USFWS. (1986, September). *Recovery plan for Florida torreya*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/FL%20torreya%20recov%20plan.pdf](http://ecos.fws.gov/docs/recovery_plan/FL%20torreya%20recov%20plan.pdf)
- USFWS. (1988). *Great lakes and northern great plains piping plover recovery plan*. Retrieved from <http://www.nwk.usace.army.mil/Portals/29/docs/regulatory/ksdredging/GreatLakesRecoveryPlan-May1988.pdf>
- USFWS. (1989, December). *Recovery plan for Alabama leather flower*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/891227.pdf](http://ecos.fws.gov/docs/recovery_plan/891227.pdf)
- USFWS. (1991a). *Recovery plan for Kral's water plantain*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/910812.pdf](http://ecos.fws.gov/docs/recovery_plan/910812.pdf)
- USFWS. (1991b). *Recovery plan for Mohr's Barbara's button*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/911126b.pdf](http://ecos.fws.gov/docs/recovery_plan/911126b.pdf)
- USFWS. (1991c). *Recovery plan for relict trillium*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/910131b.pdf](http://ecos.fws.gov/docs/recovery_plan/910131b.pdf)
- USFWS. (1992a). *Final rule for goldline darter and blue shiner*. Retrieved from [http://ecos.fws.gov/docs/federal\\_register/fr2036.pdf](http://ecos.fws.gov/docs/federal_register/fr2036.pdf)
- USFWS. (1992b). *Small whorled pogonia recovery plan*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/921113b.pdf](http://ecos.fws.gov/docs/recovery_plan/921113b.pdf)
- USFWS. (1993a). *Recovery plan for three granite outcrop species (black spored quillwort, mat-forming quillwort, and ampianthus)*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/930707.pdf](http://ecos.fws.gov/docs/recovery_plan/930707.pdf)
- USFWS. (1993b). *Recovery plan for Michaux's sumac*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/930430.pdf](http://ecos.fws.gov/docs/recovery_plan/930430.pdf)
- USFWS. (1993c). *Recovery plan for pondberry*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/930923a.pdf](http://ecos.fws.gov/docs/recovery_plan/930923a.pdf)

- USFWS. (1994a). *Final rule for Cherokee darter and Etowah darter*. Retrieved from [http://ecos.fws.gov/docs/federal\\_register/fr2753.pdf](http://ecos.fws.gov/docs/federal_register/fr2753.pdf)
- USFWS. (1994b). *Recovery plan for Tennessee yellow-eyed grass*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/940624.pdf](http://ecos.fws.gov/docs/recovery_plan/940624.pdf)
- USFWS. (1994c). *Recovery plan for Cooley's meadowrue*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/940421.pdf](http://ecos.fws.gov/docs/recovery_plan/940421.pdf)
- USFWS. (1994d). *Recovery plan for green pitcher-plant*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/941212.pdf](http://ecos.fws.gov/docs/recovery_plan/941212.pdf)
- USFWS. (1995, August). *Recovery plan for blue shiner*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/950830.pdf](http://ecos.fws.gov/docs/recovery_plan/950830.pdf)
- USFWS. (1996a). *Recovery plan for fringed campion*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/961001.pdf](http://ecos.fws.gov/docs/recovery_plan/961001.pdf)
- USFWS. (1996b). *Recovery plan for large-flowered skullcap*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/960515.pdf](http://ecos.fws.gov/docs/recovery_plan/960515.pdf)
- USFWS. (1997a). *Gray bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/pdf/gray-bat.pdf>
- USFWS. (1997b). *Recovery plan for wood stork*. Retrieved from [http://www.fws.gov/northflorida/WoodStorks/Documents/19970127\\_rpp\\_Wood-stork-recovery-plan-1997.pdf](http://www.fws.gov/northflorida/WoodStorks/Documents/19970127_rpp_Wood-stork-recovery-plan-1997.pdf)
- USFWS. (1998b, March). *Endangered Species - Consultation Handbook: Procedures for Conducting Consultation and Conference Activities Under Section 7 of the Endangered Species Act*. Retrieved from [https://www.fws.gov/endangered/esa-library/pdf/esa\\_section7\\_handbook.pdf](https://www.fws.gov/endangered/esa-library/pdf/esa_section7_handbook.pdf)
- USFWS. (2000, November). *Recovery plan for Mobile River Basin species*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/001117.pdf](http://ecos.fws.gov/docs/recovery_plan/001117.pdf)
- USFWS. (2001a, October). *Recovery plan for Florida manatee*. Retrieved from <http://www.fws.gov/northflorida/Manatee/Recovery%20Plan/manatee-recovery-plan.htm>
- USFWS. (2001b). *Critical habitat piping plover*. Retrieved from <https://www.federalregister.gov/articles/2001/07/10/01-16905/endangered-and-threatened-wildlife-and-plants-final-determination-of-critical-habitat-for-wintering>
- USFWS. (2002, September 30). *Okefenokee-Osceola Population Ecology Black Bears Sept 2002.pdf*. Retrieved July 20, 2016, from USFWS: <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0ahUKEwiI9vchIPOAhWLIR4KHd4dAFgQFggjMAE&url=https%3A%2F%2Fecos.fws.gov%2FServiceFiles%2Freference%2Fholding%2F30371%3FaccessType%3DDOWNLOAD&usg=AFQjCNHJbacwSpddifCkQwYzwfClXAF4xA&bvm=bv>.
- USFWS. (2003a). *Recovery plan for the red-cockaded woodpecker (Picoides borealis)*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/030320\\_2.pdf](http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf)
- USFWS. (2003b). *Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for Three Threatened Mussels and Eight Endangered Mussels in the Mobile River Basin*. Retrieved July 19, 2016, from [https://www.fws.gov/southeast/hotissues/mussels/proposed\\_rule.html](https://www.fws.gov/southeast/hotissues/mussels/proposed_rule.html)
- USFWS. (2003c). *Recovery plan for fat threeridge, shinyrayed pocketbook, Gulf moccasinshell, Ochlockonee moccasinshell, oval pigtoe, Chipola slabshell, and purple bankclimber*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/030930.pdf](http://ecos.fws.gov/docs/recovery_plan/030930.pdf)

- USFWS. (2003d). *Recovery plan for 7 mussels in Gulf of Mexico*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/030930.pdf](http://ecos.fws.gov/docs/recovery_plan/030930.pdf)
- USFWS. (2004). *Indiana bat (Myotis sodalis)*. Retrieved from <http://www.fws.gov/northeast/pdf/indianabat.fs.pdf>
- USFWS. (2005). *Red knot fact sheet*. Retrieved from [http://www.fws.gov/northeast/redknot/pdf/Redknot\\_BWfactsheet092013.pdf](http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf)
- USFWS. (2008a). *Loggerhead sea turtle recovery plan for northwest Atlantic Ocean population*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/090116.pdf](http://ecos.fws.gov/docs/recovery_plan/090116.pdf)
- USFWS. (2008b, April 12). *Fine-lined Pocketbook...5-Year Review: Evaluation and Summary*. Retrieved July 21, 2016, from [https://www.fws.gov/ecos/ajax/docs/five\\_year\\_review/doc2365.pdf](https://www.fws.gov/ecos/ajax/docs/five_year_review/doc2365.pdf)
- USFWS. (2008c). *American Chaffseed (Schwalbea americana) 5-year Review: Summary and Evaluation*. Retrieved from [http://www.fws.gov/northeast/EcologicalServices/pdf/endangered/5\\_yr\\_chaffseed.pdf](http://www.fws.gov/northeast/EcologicalServices/pdf/endangered/5_yr_chaffseed.pdf)
- USFWS. (2008d). *Small Whorled Pogonia (Isotria medeoloides)*. Retrieved from <http://www.fws.gov/midwest/endangered/plants/pdf/smallwhorledpogoniafactsht.pdf>
- USFWS. (2008e). *Five Year Review: Ozark Big-Eared Bat*. Retrieved from [https://ecos.fws.gov/docs/five\\_year\\_review/doc1912.pdf](https://ecos.fws.gov/docs/five_year_review/doc1912.pdf)
- USFWS. (2009a). *Soil-Disturbance Field Guide*. Retrieved September 2015, from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFWS. (2009b). *Final rule on flatwoods salamanders*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2009-02-10/pdf/E9-2403.pdf#page=1>
- USFWS. (2009c). *Recovery plan for smalltooth sawfish*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/smalltoothsawfish.pdf](http://ecos.fws.gov/docs/recovery_plan/smalltoothsawfish.pdf)
- USFWS. (2011a). *Final rule for Altamaha spinymussel*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2011-10-11/pdf/2011-25539.pdf>
- USFWS. (2011b). *Canby's dropwort (Oxypolis canbyi) summary*. Retrieved from [http://www.fws.gov/raleigh/species/es\\_canbys\\_dropwort.html](http://www.fws.gov/raleigh/species/es_canbys_dropwort.html)
- USFWS. (2012a). *Guidance on developing and implementing an Indiana bat conservation plan*. Retrieved from [http://www.fws.gov/northeast/pafo/pdf/IBATconservationplanguidance\\_PAFO\\_040412.pdf](http://www.fws.gov/northeast/pafo/pdf/IBATconservationplanguidance_PAFO_040412.pdf)
- USFWS. (2012b). *Rayed bean freshwater mussel (Villosa fabalis)*. Retrieved from <http://www.fws.gov/midwest/endangered/clams/rayedbean/pdf/RayedBeanFactSheet.pdf>
- USFWS. (2013a). *Birds Protected by the Migratory Bird Treaty Act*. Retrieved from <http://www.fws.gov/migratorybirds/regulationspolicies/mbta/mbtintro.html>
- USFWS. (2013b). *Red Knot Fact Sheet*. Retrieved from [http://www.fws.gov/northeast/redknot/pdf/Redknot\\_BWfactsheet092013.pdf](http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf)
- USFWS. (2013c). *Proposed Rule for Georgia Rockcress*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2013-09-12/pdf/2013-22129.pdf>
- USFWS. (2014a). *Candidate Species - Section 4 of the Endangered Species Act*. Retrieved from [https://www.fws.gov/endangered/esa-library/pdf/candidate\\_species.pdf](https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf)
- USFWS. (2014b, February 2). *Candidate Species Believed to or Known to Occur in Georgia*. Retrieved July 20, 2016, from <http://ecos.fws.gov/ecp0/reports/species-listed-by-state-report?state=GA&status=candidate>

- USFWS. (2014c). *Rufa Red Knot Background Information and Threats Assessment*. Retrieved from [http://www.fws.gov/northeast/redknot/pdf/20141125\\_REKN\\_FL\\_supplemental\\_doc\\_FIN\\_AL.pdf](http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_supplemental_doc_FIN_AL.pdf)
- USFWS. (2014d, October 31). *Recovery Plan for Georgia Pigtoe Mussel, Interrupted Rocksnail, and Rough Hornsnail*. (U.S. Fish and Wildlife, Southeast Region) Retrieved July 21, 2016, from [http://ecos.fws.gov/docs/recovery\\_plan/2014%2010%2031%20%20Three%20Mollusks%20final%20recovery%20plan.pdf](http://ecos.fws.gov/docs/recovery_plan/2014%2010%2031%20%20Three%20Mollusks%20final%20recovery%20plan.pdf)
- USFWS. (2014e). *Recovery Plan Interrupted Rocksnail*. Retrieved from [http://ecos.fws.gov/docs/recovery\\_plan/2014%2010%2031%20%20Three%20Mollusks%20final%20recovery%20plan.pdf](http://ecos.fws.gov/docs/recovery_plan/2014%2010%2031%20%20Three%20Mollusks%20final%20recovery%20plan.pdf)
- USFWS. (2014f). *American Chaffseed (Schwalbea americana)*. Retrieved from <http://www.fws.gov/northeast/njfieldoffice/Endangered/chaffseed.html>
- USFWS. (2014g). *Final Rule for Whorled Sunflower*. Retrieved from <http://www.gpo.gov/fdsys/pkg/FR-2014-08-01/pdf/2014-18103.pdf>
- USFWS. (2015a, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: <http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html>
- USFWS. (2015aa). *Piping plover (Charadrius melodus)*. Retrieved from [http://www.fws.gov/charleston/pdf/PIPL\\_page.pdf](http://www.fws.gov/charleston/pdf/PIPL_page.pdf)
- USFWS. (2015ab). *Piping plover, Atlantic Coast population*. Retrieved from <http://www.fws.gov/northeast/pipingplover/overview.html>
- USFWS. (2015ac). *Red-cockaded woodpecker recovery*. Retrieved from <http://www.fws.gov/rcwrecovery/rcw.html>
- USFWS. (2015ad). *Species profile for red-cockaded woodpecker (Picoides borealis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=B04F>
- USFWS. (2015ae). *Species profile for red knot (Calidris canutus rufa)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=B0DM>
- USFWS. (2015af). *Species profile for wood stork (Mycteria americana)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=B06O](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=B06O)
- USFWS. (2015ag). *Species profile for frosted flatwoods salamander (Ambystoma cingulatum)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=D013](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=D013)
- USFWS. (2015ah). *Species profile for amber darter (Percina antesella)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile.action?sPCODE=E05F](http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=E05F)
- USFWS. (2015ai). *Species profile for blue shiner (Cyprinella caerulea)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=E05Y](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=E05Y)
- USFWS. (2015aj). *Species profile for Cherokee darter (Etheostoma scotti)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=E03J](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=E03J)
- USFWS. (2015ak). *Species profile for Conasauga logperch (Percina jenkinsi)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=E05H](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=E05H)
- USFWS. (2015al). *Species profile for Etowah darter (Etheostoma etowahae)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=E089](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=E089)
- USFWS. (2015am). *Species profile for goldline darter (Percina aurolineata)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?sPCODE=E05S](http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=E05S)

- USFWS. (2015an). *Species profile for shortnose sturgeon (Acipenser brevirostrum)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E00B>
- USFWS. (2015ao). *Species profile for smalltooth sawfish (Pristis pectinata)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=E0A9](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E0A9)
- USFWS. (2015ap). *Species profile for snail darter (Percina tanasi)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=E010](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E010)
- USFWS. (2015aq). *Species profile for Alabama moccasinshell (Medionidus acutissimus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F038](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F038)
- USFWS. (2015ar, March 30). *Federally Threatened and Endangered Invertebrates found in Georgia*. Retrieved from Georgia Ecological Services Field Offices: [http://www.fws.gov/athens/endangered/teinverts%20\(2\).html](http://www.fws.gov/athens/endangered/teinverts%20(2).html)
- USFWS. (2015as). *Species profile for Altamaha spinymussel (Elliptio spinosa)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F026](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F026)
- USFWS. (2015at). *Species profile for Coosa moccasinshell (Medionidus parvulus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F039](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F039)
- USFWS. (2015au). *Species profile for fat threeridge (Amblema neislerii)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F032](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F032)
- USFWS. (2015av). *Species profile for finelined pocketbook (Lampsilis altilis)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F02X](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02X)
- USFWS. (2015aw, October). *Species profile for finelined pocketbook (Lampsilis altilis)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F02X](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02X)
- USFWS. (2015ax). *Species profile for Georgia pigtoe (Pleurobema hanleyianum)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F03Z](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F03Z)
- USFWS. (2015ay). *Species profile for Gulf moccasinshell (Medionidus penicillatus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F03M](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F03M)
- USFWS. (2015az). *Species profile for Ochlockonee moccasinshell (Medionidus simpsonianus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F03N](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F03N)
- USFWS. (2015b, January 26). *Data Limitations, Exclusions, and Precautions*. Retrieved May 11, 2015, from <http://www.fws.gov/wetlands/Data/Limitations.html>
- USFWS. (2015ba). *Species profile for oval pigtoe (Pleurobema pyriforme)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F02S](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02S)
- USFWS. (2015bb). *Species profile for purple bankclimber (Elliptoideus sloatianus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F02E](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02E)
- USFWS. (2015bc). *Species profile for shinyrayed pocketbook (Lampsilis subangulata)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F02Y](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F02Y)
- USFWS. (2015bd). *Species profile for southern clubshell (Pleurobema decisum)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F036](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F036)
- USFWS. (2015be). *Species profile for southern pigtoe (Pleurobema georgianum)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F03B](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F03B)
- USFWS. (2015bf). *Species profile for triangular kidneyshell (Ptychobranchus greenii)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=F037](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=F037)
- USFWS. (2015bg). *Species profile for Alabama leather flower (Clematis socialis)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=Q2SM](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2SM)
- USFWS. (2015bh). *Species profile for black spored quillwort (Isoetes melanospora)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=S015](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=S015)

- USFWS. (2015bi). *Species profile for Canby's dropwort (Oxypolis canbyi)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?scode=Q2EL>
- USFWS. (2015bj). *Species profile for Cooley's meadowrue (Thalictrum cooleyi)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q231](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q231)
- USFWS. (2015bk). *Species profile for Florida torreyia (Torreyia taxifolia)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=R006](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=R006)
- USFWS. (2015bl). *Species profile for fringed campion (Silene polypetala)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q21P](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q21P)
- USFWS. (2015bm). *Species profile for Georgia rockcress (Arabis georgiana)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q02R](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q02R)
- USFWS. (2015bn). *Species profile for green pitcher-plant (Sarracenia oreophila)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q21B](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q21B)
- USFWS. (2015bo). *Species profile for hairy rattleweed (Baptisia arachnifera)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q1TD](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q1TD)
- USFWS. (2015bp). *Raleigh Ecological Services Field Office Harperella*. Retrieved from [http://www.fws.gov/raleigh/species/es\\_harperella.html](http://www.fws.gov/raleigh/species/es_harperella.html)
- USFWS. (2015bq). *Species profile for harperella (Ptilimnium nodosum)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?scode=Q2H9>
- USFWS. (2015br). *Species profile for Kral's water-plantain (Sagittaria secundifolia)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q2VT](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q2VT)
- USFWS. (2015bs). *Species profile for large-flowered skullcap (Scutellaria montana)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q2IA](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q2IA)
- USFWS. (2015bt). *Species profile for little amphianthus (Amphianthus pusillus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q1ST](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q1ST)
- USFWS. (2015bu). *Species profile for mat-forming quillwort (Isoetes tegetiformans)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=S019](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=S019)
- USFWS. (2015bv). *Michaux's sumac (Rhus michauxii)*. Retrieved from [http://www.fws.gov/raleigh/species/es\\_michauxs\\_sumac.html](http://www.fws.gov/raleigh/species/es_michauxs_sumac.html)
- USFWS. (2015bw). *Species profile for Mohr's Barbara's button (Marshallia mohrii)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q1YT](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q1YT)
- USFWS. (2015bx). *Species profile for persistent trillium (Trillium persistens)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q23D](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q23D)
- USFWS. (2015by). *Species profile for pondberry (Lindera melissifolia)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q2CO](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q2CO)
- USFWS. (2015bz). *Species profile for relict trillium (Trillium reliquum)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=Q2RG](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=Q2RG)
- USFWS. (2015c). *Listed species believed to or known to occur in Georgia*. Retrieved from [http://ecos.fws.gov/tess\\_public/reports/species-listed-by-state-report?state=GA&status=listed](http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=GA&status=listed)
- USFWS. (2015ca). *Rock gnome lichen (Gymnoderma lineare)*. Retrieved from [http://www.fws.gov/raleigh/species/es\\_rock\\_gnome\\_lichen.html](http://www.fws.gov/raleigh/species/es_rock_gnome_lichen.html)
- USFWS. (2015cb). *Species profile for rock gnome lichen (Gymnoderma lineare)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?scode=U001](http://ecos.fws.gov/tess_public/profile/speciesProfile?scode=U001)
- USFWS. (2015cc). *Species profile for small whorled pogonia (Isotria medeoloides)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?scode=Q1XL>

- USFWS. (2015cd). *Smooth coneflower (Echinacea laevigata)*. Retrieved from [http://www.fws.gov/raleigh/species/es\\_smooth\\_coneflower.html](http://www.fws.gov/raleigh/species/es_smooth_coneflower.html)
- USFWS. (2015ce). *Swamp Pink fact sheet*. Retrieved from <http://www.fws.gov/northeast/pdf/swamppin.pdf>
- USFWS. (2015cf). *Species profile for Tennessee yellow-eyed grass (Xyris tennesseensis)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=Q2MP](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q2MP)
- USFWS. (2015cg). *Species profile for Virginia spiraea (Spiraea virginiana)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2R1>
- USFWS. (2015ch). *Species profile for whorled sunflower (Helianthus verticillatus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=Q3HO](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q3HO)
- USFWS. (2015ci). *Okefenokee National Wildlife Refuge*. Retrieved October 2015, from <http://www.fws.gov/refuge/Okefenokee/>
- USFWS. (2015cj). *About the Complex*. Retrieved October 2015, from [http://www.fws.gov/refuge/Savannah/About\\_the\\_Complex.html](http://www.fws.gov/refuge/Savannah/About_the_Complex.html)
- USFWS. (2015ck, April). *National Wildlife Refuge System*. Retrieved April 17, 2015, from <http://www.fws.gov/refuges/>
- USFWS. (2015cl). *Georgia*. Retrieved October 25, 2015, from <http://www.fws.gov/refuges/refugeLocatorMaps/Georgia.html>
- USFWS. (2015cm, October 16). *Savannah National Wildlife Refuge*. Retrieved October 25, 2015, from <http://www.fws.gov/refuge/Savannah/>
- USFWS. (2015d). *Critical habitat portal*. Retrieved from <http://ecos.fws.gov/crithab/>
- USFWS. (2015e). *Candidate species believed to or known to occur in Georgia*. Retrieved from [http://ecos.fws.gov/tess\\_public/reports/species-listed-by-state-report?state=GA&status=candidate](http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=GA&status=candidate)
- USFWS. (2015f). *Species profile for gray bat (Myotis grisescens)*. Retrieved from <https://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A04J>
- USFWS. (2015g). *Roost*. Retrieved from <https://www.fws.gov/midwest/endangered/mammals/inba/curriculum/Glossary.pdf>
- USFWS. (2015h). *Indiana bat (Myotis sodalis) fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/inba/inbafactsht.html>
- USFWS. (2015i). *Indiana bat (Myotis sodalis)*. Retrieved from <https://www.fws.gov/midwest/endangered/mammals/inba/index.html>
- USFWS. (2015j). *Species profile for Indiana bat (Myotis sodalis)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A000>
- USFWS. (2015k). *Hibernation*. Retrieved from <https://www.fws.gov/midwest/endangered/mammals/inba/curriculum/Glossary.pdf>
- USFWS. (2015l). *Northern long-eared bat fact sheet*. Retrieved from <http://www.fws.gov/midwest/endangered/mammals/nleb/nlebfactsheet.html>
- USFWS. (2015m). *Species profile for northern long-eared bat*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A0JE>
- USFWS. (2015n). *Species profile for finback whale (Balaenoptera physalus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A02O>
- USFWS. (2015o). *Species profile for humpback whale (Megaptera novaeangliae)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A02Q>
- USFWS. (2015p). *Species profile for West Indian manatee (Trichechus manatus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile?spcode=A007>

- USFWS. (2015q). *Species profile for eastern indigo snake (Drymarchon corais couperi)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile?spcode=C026](http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=C026)
- USFWS. (2015r). *Hawksbill sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/hawksbill-sea-turtle.htm>
- USFWS. (2015s). *Species profile for hawksbill sea turtle (Eretmochelys imbricata)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00E>
- USFWS. (2015t). *Kemp's ridley sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Kemps-Ridley-Sea-Turtle.pdf>
- USFWS. (2015u). *Species profile for Kemp's ridley sea turtle (Lepidochelys kempii)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C000>
- USFWS. (2015v). *Leatherback sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Leatherback-Sea-Turtle.pdf>
- USFWS. (2015w). *Species profile for leatherback sea turtle (Dermochelys coriacea)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00F>
- USFWS. (2015x). *Loggerhead sea turtle fact sheet*. Retrieved from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Loggerhead-Sea-Turtle.pdf>
- USFWS. (2015y). *Species profile for loggerhead sea turtle (Caretta caretta)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00U>
- USFWS. (2015z). *Species profile for piping plover (Charadrius melodus)*. Retrieved from [http://ecos.fws.gov/tess\\_public/profile/speciesProfile.action?spcode=B079](http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B079)
- USFWS. (2016a). *Critical Habitat Portal*. Retrieved July 20, 2016, from ECOS - Environmental Conservation Online System: <http://ecos.fws.gov/ecp/report/table/critical-habitat.html>
- USFWS. (2016b). *Rufa Red Knot (Calidris canutus rufa) [threatened]*. Retrieved July 15, 2016, from <https://www.fws.gov/northeast/njfieldoffice/endangered/redknot.html>
- USFWS. (2017a, May). *National Wetlands Inventory*. Retrieved June 2017, from U.S. Fish and Wildlife Service: <https://www.fws.gov/wetlands/data/Mapper.html>
- USFWS. (2017b, March). *Endangered and Threatened Wildlife and Plants: Reclassification of the West Indian Manatee From Endangered to Threatened*. Retrieved June 2017, from <https://www.fws.gov/southeast/pdf/west-indian-manatee-reclassification-final-rule.pdf>
- USG. (2004). *Geographic Regions of Georgia*. Retrieved June 2017, from <http://georgiainfo.galileo.usg.edu/topics/geography/article/geographic-regions-of-georgia>
- USGCRP. (2009). *Global Climate Change Impacts in the United States*. New York: Cambridge University Press. Retrieved from <https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>
- USGCRP. (2014a). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: <http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change>
- USGCRP. (2014b). *National Climate Assessment: Coastal Zone Development and Ecosystems*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/coasts#narrative-page-16832>
- USGCRP. (2014c). *National Climate Assessment: Changes in Storms*. Retrieved July 9, 2015, from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/our-changing-climate/changes-storms>

- USGCRP. (2014d). *National Climate Assessment - Coastal Zone Development and Ecosystems*. Retrieved December 31, 2015, from <http://nca2014.globalchange.gov/report/regions/coasts#intro-section-2>
- USGCRP. (2014e). *National Climate Assessment - Extreme Weather*. Retrieved October 6, 2015, from <http://nca2014.globalchange.gov/report/our-changing-climate/extreme-weather#intro-section-2>
- USGS. (1976). *Appendix C: Land Use Definitions - A Land Use And Land Cover Classification System For Use With Remote Sensor Data*. Retrieved June 2017, from [https://www.usbr.gov/lc/socal/reports/SMappend\\_C.pdf](https://www.usbr.gov/lc/socal/reports/SMappend_C.pdf)
- USGS. (1995a). *Floridian Aquifer System*. Retrieved August 11, 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text6.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text6.html)
- USGS. (1995b). *Valley and Ridge Aquifers*. Retrieved September 16, 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_l/L-text5.html](http://pubs.usgs.gov/ha/ha730/ch_l/L-text5.html)
- USGS. (1996). *Summary of Data-Collection Activities and Effects of Flooding from Tropical Storm Alberto in Parts of Georgia, Alabama, and Florida, July 1994*. Retrieved from U.S. Geological Survey: <http://pubs.usgs.gov/of/1996/ofr96-228/pdf/ofr96-228.pdf>
- USGS. (1997). *Programs in Georgia*. Retrieved October 2015, from <http://pubs.usgs.gov/fs/FS-010-96/>
- USGS. (1999). *How Ground Water Occurs*. Retrieved February 12, 2013, from U.S. Geological Survey General Interest Publication: [http://pubs.usgs.gov/gip/gw/how\\_a.html](http://pubs.usgs.gov/gip/gw/how_a.html)
- USGS. (2000). *Land Subsidence in the United States (Fact Sheet 165-00)*. Retrieved September 2013, from <http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF>
- USGS. (2001a). *Groundwater Conditions and Studies in Georgia*. Retrieved October 2015, from <http://pubs.usgs.gov/wri/wri034032/pdf/Ufl-intro-wl.pdf>
- USGS. (2001b). *Elevations and Distances in the United States*. Retrieved June 2017, from <https://pubs.usgs.gov/gip/Elevations-Distances/elvadist.html>
- USGS. (2003a). *A Tapestry of Time and Terrain: The Union of Two Maps, Geology and Topography*. Retrieved September 2013
- USGS. (2003b). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from <http://pubs.usgs.gov/circ/c1244/c1244.pdf>
- USGS. (2005). *Atlas of Water Resources in the Black Hills Area, South Dakota*. Retrieved August 2015, from <http://pubs.usgs.gov/ha/ha747/>
- USGS. (2010). *What is "Peak Acceleration" or "Peak Ground Acceleration" (PGA)?* Retrieved April 2015, from <http://geohazards.usgs.gov/deaggint/2002/documentation/parm.php>
- USGS. (2012). *Earthquake Glossary - Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=earthquake>
- USGS. (2013a, June 17). *Water Basics Glossary*. Retrieved February 2016, from [http://water.usgs.gov/water-basics\\_glossary.html](http://water.usgs.gov/water-basics_glossary.html)
- USGS. (2013b). *Glossary of Glacier Terminology*. Retrieved August 2015, from <http://pubs.usgs.gov/of/2004/1216/text.html#tz>
- USGS. (2013c). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from <http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/>
- USGS. (2014a). *Sedimentary Rocks*. Retrieved July 2015, from <http://geomaps.wr.usgs.gov/parks/rxmin/rock2.html>
- USGS. (2014b). *Measuring the Size of an Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/topics/measure.php>

- USGS. (2014c). *Landslide Overview Map of the Conterminous United States*. Retrieved June 2015, from <http://landslides.usgs.gov/hazards/nationalmap/>
- USGS. (2014d). *Karst in the United States: A Digital Map Compilation and Database*. Retrieved October 2015, from <http://pubs.usgs.gov/of/2014/1156/pdf/of2014-1156.pdf>
- USGS. (2014e, November). *Water Resources of the United States*. Retrieved July 2015, from <http://www.usgs.gov/water/>
- USGS. (2014f). *National Atlas of the United States*. Retrieved Septmeber 2015, from [http://nationalmap.gov/small\\_scale/printable/fedlands.html](http://nationalmap.gov/small_scale/printable/fedlands.html)
- USGS. (2015a, September 8). *Geographic Names Information System (GNIS)*. Retrieved September 8, 2015, from <http://geonames.usgs.gov/apex/f?p=136:1:2933318154716>
- USGS. (2015b). *Water Science Glossary of Terms*. Retrieved June 2015, from <http://water.usgs.gov/edu/dictionary.html#B>
- USGS. (2015c). *Paleontology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?term=861>
- USGS. (2015d). *Structural Geology*. Retrieved July 2015, from <https://mrdata.usgs.gov/catalog/mobile/browse.php?thcode=2&code=1117>
- USGS. (2015e). *Geologic Processes*. Retrieved Nov 16, 2015, from <http://www.usgs.gov/science/science.php?term=1145>
- USGS. (2015f). *Groundwater Atlas of the United States - Alabama, Florida, Georgia, South Carolina (Southeastern Coastal Plain Aquifer System)*. Retrieved October 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text7.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text7.html)
- USGS. (2015g). *Geologic Glossary*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/misc/glossarya.html>
- USGS. (2015h). *Groundwater Atlas of the United States -- Alabama, Florida, Georgia, South Carolina (Piedmont and Blue Ridge Aquifers)*. Retrieved October 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text8.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text8.html)
- USGS. (2015i). *Groundwater Atlas of the United States - Alabama, Florida, Georgia, South Carolina (Valley and Ridge aquifers)*. Retrieved October 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text9.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text9.html)
- USGS. (2015j). *Groundwater Atlas of the United States - Alabama, Florida, Georgia, South Carolina (Appalachian Plateaus and Interior Low Plateaus aquifers)*. Retrieved October 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text10.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text10.html)
- USGS. (2015k). *Groundwater Atlas of the United States - Alabama, Florida, Georgia, South Carolina*. Retrieved October 2015, from [http://pubs.usgs.gov/ha/ha730/ch\\_g/G-text1.html](http://pubs.usgs.gov/ha/ha730/ch_g/G-text1.html)
- USGS. (2015l). *2010-2011 Minerals Yearbook*. Retrieved November 2015, from [http://minerals.usgs.gov/minerals/pubs/state/2010\\_11/myb2-2010\\_11-ga.pdf](http://minerals.usgs.gov/minerals/pubs/state/2010_11/myb2-2010_11-ga.pdf)
- USGS. (2015m). *About U.S. Volcanoes*. Retrieved August 2015, from <http://volcanoes.usgs.gov/about/volcanoes/>
- USGS. (2015n). *Historic Flooding in Northern Georgia, September 16-22, 2009*. Retrieved from Georgia Water Science Center: <http://pubs.usgs.gov/fs/2010/3061/pdf/fs2010-3061.pdf>
- USGS. (2015o). *National Water-Quality Assessment Program*. Retrieved July 6, 2015, from <http://pubs.usgs.gov/circ/1353/>
- USGS. (2016a, January 28). *Minerals Commodity Summaries 2016*. Retrieved October 23, 2015, from Minerals Information: <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>

- USGS. (2016b). *Tectonic Processes*. Retrieved from <http://www.usgs.gov/science/science.php?code=1145&thcode=2>
- USGS. (2016c, November). *Georgia Land Cover*. Retrieved June 2017, from The USGS Land Cover Institute (LCI): <http://landcover.usgs.gov/georgia.php>
- USGS. (2016d, April 21). *National Gap Analysis Program (GAP) | Protected Areas Data Viewer*. Retrieved April 21, 2016, from <http://gis1.usgs.gov/csas/gap/viewer/padus/Map.aspx>
- USGS. (2016e). *Physical Agents of Land Loss: Relative Sea Level*. Retrieved from An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States: <http://pubs.usgs.gov/of/2003/of03-337/sealevel.html>
- USGS. (2016f, February 10). *Explanations for the National Water Conditions*. Retrieved from Water Resources of the United States: [http://water.usgs.gov/nwc/explain\\_data.html](http://water.usgs.gov/nwc/explain_data.html)
- USGS. (2017). *Regions Overview*. Retrieved June 2017, from U.S. Geological Survey: <https://www2.usgs.gov/state/state.asp?State=GA>
- USGS NWHC. (2015). *White-Nose Syndrome (WNS)*. Retrieved from USGS National Wildlife Health Center: [http://www.nwhc.usgs.gov/disease\\_information/white-nose\\_syndrome/](http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/)
- UVA Weldon Cooper Center. (2015a). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file [USProjections\\_2020to2040\\_all\\_data\\_updated\\_noshapefile.zip](http://www.coopercenter.org/demographics/national-population-projections). Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- UVA Weldon Cooper Center. (2015b). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file [USProjections\\_2020to2040\\_all\\_data\\_updated\\_noshapefile.zip](http://www.coopercenter.org/demographics/national-population-projections). Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- VirginiaPlaces.org. (2016). *Geology of the Fall Line*. Retrieved July 19, 2016, from VirginiaPlaces.org: <http://www.virginiaplaces.org/regions/fallshape.html>
- Waggoner, J. C. (2009). Fiber-Tempered Pottery, Soapstone Vessels, and Shifting Alliances in the Interior Coastal Plain of the Late Archaic Southeast. *Southeastern Archaeology*, 28(2), 137-147. Retrieved October 2015, from <http://www.jstor.org/stable/40713515>
- Walker, R. B., Detwiler, K. R., Meeks, S. C., & Driskell, B. N. (2001). Berries, Bones, and Blades: Reconstructing Late Paleoindian Subsistence Economy at Dust Cave, Alabama. *Midcontinental Journal of Archaeology*, 169-197. Retrieved October 2015, from <http://www.jstor.org/stable/20708158>
- Wilderness.net. (2015a). *Wilderness Data Search Results*. Retrieved September 27, 2015, from <http://www.wilderness.net/NWPS/stateView?state=WI>
- Wilderness.net. (2015b). *The Wilderness Act of 1964*. Retrieved September 17, 2015, from <http://www.wilderness.net/nwps/legisact>
- Wilderness.net. (2015c). *List Wilderness Areas by Location: Georgia*. Retrieved October 25, 2015, from <http://www.wilderness.net/NWPS/stateView?state=GA>
- WVDNR. (2015). *Rare, threatened, and endangered species in West Virginia - Virginia spiraea*. Retrieved from <http://www.wvdnr.gov/wildlife/RETSpecies.asp>
- WWF. (2015). *What is an ecoregion?* Retrieved from [http://wwf.panda.org/about\\_our\\_earth/ecoregions/about/what\\_is\\_an\\_ecoregion/](http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/)

- Wyde, M. (2016, June 8). National Toxicology Program Finds Cell Phone Radiation Causes Cancer. Ghent, Belgium.
- Yan Zhou, M. S. (2009, March). Atlanta's urban heat island under extreme heat conditions and potential mitigation strategies. *Natural Hazards*. Retrieved April 27, 2016, from [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwittZDzra\\_MAhXMLB4KHYdqAcwQFgg9MAU&url=https%3A%2F%2Fwww.researchgate.net%2Fpublication%2F226081824\\_Atlanta's\\_urban\\_heat\\_island\\_under\\_extreme\\_heat\\_conditions\\_and\\_pote](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwittZDzra_MAhXMLB4KHYdqAcwQFgg9MAU&url=https%3A%2F%2Fwww.researchgate.net%2Fpublication%2F226081824_Atlanta's_urban_heat_island_under_extreme_heat_conditions_and_pote)

## GIS REFERENCES

- BIA. (2003 December). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://sagemap.wr.usgs.gov/ftp/regional/ind3.html> and <http://www.arcgis.com/home/item.html?id=2e915ef3df48422283e5b2c7d89dfcba>
- BLS. (2015). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages.: <http://www.bls.gov/lau/rdscnp16.htm>
- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: MTR Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: <https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services>
- Digital Aeronautical Flight Information File. (2015, June). Land Use, Recreation, and Airspace: SUA Airspace. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: <https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services>
- Environmental Systems Research Institute (ESRI). (2016). All Maps. (GIS Metadata) Retrieved August 2015, from [http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&\\_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1](http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1)
- FAA. (2015, June). Infrastructure: Transportation. (GIS Metadata) Retrieved June 2015, from Airport hubs data. Data is updated every 8 weeks. Data downloaded by state: [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)
- FAA. (2015, June). Land Use, Recreation, and Airspace: Composite Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks: [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)
- FAA. (2015, June). Land Use, Recreation, and Airspace: Private Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks. : [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)
- FAA. (2015, June). Land Use, Recreation, and Airspace: Public Airspace. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks.: [http://www.faa.gov/airports/airport\\_safety/airportdata\\_5010/](http://www.faa.gov/airports/airport_safety/airportdata_5010/)
- FCC. (2014, June). Infrastructure: FCC Towers. (GIS Metadata) Retrieved August 2015, from Data was obtained through a more advanced search by BAH being in direct touch with

- Cavell, Mertz & Associates to obtain ALL the relevant data across the country.:  
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrAdvancedSearch.jsp>
- FCC. (2014, June). Infrastructure: FCC Wireless. (GIS Metadata) Retrieved August 2015, from David F. LaBranche, P.E. Geospatial Information Officer (GIO) OASD (EI&E) 571-372-6768 at Defense Installations Spatial Data Infrastructure (DISDI).:  
<http://www.broadbandmap.gov/data-download>
- FCC. (2015). Infrastructure: FCC Fiber. (GIS Metadata) Retrieved August 2015, from  
<http://www.broadbandmap.gov/data-download>
- FHWA. (2015, September 14). Infrastructure: Transportation. (GIS Metadata) Retrieved September 14, 2015, from Byways and National Scenic Trails; Gary A. Jensen; Research Implementation Team Leader; FHWA; 1200 New Jersey Ave, SE Room E76-304:  
<http://www.fhwa.dot.gov/byways/> [https://www.nps.gov/ncrc/programs/nts/nts\\_trails.html](https://www.nps.gov/ncrc/programs/nts/nts_trails.html)
- FHWA. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved August 2015, from National Scenic Byways Program. Data obtained by Gary A. Jensen, Research Implementation Team Leader, Office of Human Environment HEPH-30, Federal Highway Administration, 1200 New Jersey Avenue, SE Room E76-304, Washington, DC 20590, 202-366-2048, gary.je: <http://www.fhwa.dot.gov/byways/>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from NPS:  
<https://www.rivers.gov/mapping-gis.php>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). Water Resources: Surface Water / Watershed. (GIS Metadata) Retrieved September 2015, from National Wild and Scenic Rivers Program, NPS, Department of Interior:  
<https://www.rivers.gov/mapping-gis.php>
- National Audubon Society. (2015). Biological Resources: Important Bird Areas. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:  
[http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas\\_poly/MapServer](http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_poly/MapServer)
- National Heritage Areas Program Office. (2011). Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive. (GIS Metadata) Retrieved August 2015, from Department of Interior, National Parks Service, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- National Heritage Areas Program Office. (2015, April). Cultural Resources: National Heritage. (GIS Metadata) Retrieved September 2015, from Department of Interior, NPS, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- Native Languages of the Americas. (2015). Cultural Resources: Approximate Historic Boundaries of Tribes. (GIS Metadata) Retrieved August 2015, from <http://www.native-languages.org/states.htm>
- NERR. (2012). Water Resources: Estuaries and Critical Resource Waters. (GIS Metadata) Retrieved August 2015, from NOAA, Office of Coastal Management, National Estuarine Research Reserve System (NERRS): <http://cdmo.baruch.sc.edu/get/gis.cfm>
- NPS. (2011). Air Quality: Class 1 Areas. (GIS Metadata) Retrieved August 2015, from <http://science.nature.nps.gov/im/gis/index.cfm>
- NPS. (2015). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior:  
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>

- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:  
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [National Monuments and Icons]:  
[http://mapservices.nps.gov/arcgis/rest/services/cultural\\_resources/nhl\\_public/MapServer](http://mapservices.nps.gov/arcgis/rest/services/cultural_resources/nhl_public/MapServer)
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, National Parks Service, Department of Interior [National Scenic and Historic trails]: [https://www.nps.gov/nrcr/programs/nts/nts\\_trails.html](https://www.nps.gov/nrcr/programs/nts/nts_trails.html)
- NPS. (2015, August). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]:  
<http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NRCS. (2006). Soils: Soil Suborders. Retrieved April 2015, from Downloaded by state-level:  
<https://gdg.sc.egov.usda.gov/>
- NRHP. (2015). Cultural Resources: National Heritage. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.:  
<https://irma.nps.gov/DataStore/Reference/Profile/2210280>
- U.S. Census Bureau. (2015c). Environmental Justice. (GIS Metadata) Retrieved July 2015, from U.S. Environmental Protection Agency. "EJSCREEN Environmental Justice Mapping and Screening Tool: EJSCREEN Technical Documentation."  
<http://www2.epa.gov/ejscreen/technical-documentation-ejscreen>
- U.S. Census Bureau. (2015f, April). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions. 2013\_ACSSubjectDefinitions:  
[http://www2.census.gov/programs-surveys/acs/tech\\_docs/subject\\_definitions/2013\\_ACSSubjectDefinitions.pdf](http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf)
- U.S. Census Bureau. (2015j). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Obtained via Census Bureau online DataFerrett tool.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Environmental Justice. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:  
<http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Median Household Income. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas:  
<http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Population Distribution. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010

- urbanized areas and urban clusters for the U.S. first sorted by state FIPS code, then USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). Socioeconomics: Unemployment. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code then by USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. DOT Bureau of Transportation Statistics National Transportation Atlas Database. (2015). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Railroads, Major Highways data: [http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national\\_transportation\\_atlas\\_database/2015/polyline](http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/2015/polyline)
- United States National Atlas. (2014). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from [http://nationalmap.gov/small\\_scale/](http://nationalmap.gov/small_scale/)
- United States National Atlas. (2014). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from [http://nationalmap.gov/small\\_scale/](http://nationalmap.gov/small_scale/)
- USACE. (2015, March 17). Infrastructure: Transportation. (GIS Metadata) Retrieved August 2015, from Port Data. Has since been updated:  
<http://www.navigationdatacenter.us/gis/gis1.htm>
- USEPA. (2011). Water Resources: Principal Aquifers. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/dwssa/map-sole-source-aquifer-locations>
- USEPA. (2013). Biological Resources: Ecoregions. (GIS Metadata) Retrieved August 2015, from Level III and IV ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, Map scale 1:3,000,000:  
[http://www.epa.gov/wed/pages/ecoregions/level\\_iii\\_iv.htm](http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm)
- USEPA. (2014). Water Resources: Impaired Water. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/waterdata/waters-geospatial-data-downloads>
- USEPA. (2015). Human Health and Safety: TRI. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:  
<https://map11.epa.gov/arcgis/rest/services/NEPAssist/NEPAVELayersPublic>
- USEPA. (2015b, April 21). Air Quality: Nonattainment Areas. (GIS Metadata) Retrieved August 2015, from The Green Book Nonattainment Areas for Criteria Pollutants:  
[https://www3.epa.gov/airquality/greenbook/gis\\_download.html](https://www3.epa.gov/airquality/greenbook/gis_download.html)
- USFWS. (2014). Wetlands. (GIS Metadata) Retrieved August 2015, from State level data layer:  
<https://www.fws.gov/wetlands/Data/Data-Download.html>
- USFWS. (2015). Biological Resources: Critical Habitat. Retrieved September 2015, from <https://www.fws.gov/gis/data/national/>
- USFWS. (2015, December 4). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from National Wildlife Refuge Boundaries:  
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USFWS. (2015, December 14). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from USFWS National Wildlife Refuge System, Realty Division:  
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USGS. (1999 to 2001). Visual Resources: Land Cover. (GIS Metadata) Retrieved August 2015, from USGS GAP Analysis Land Cover, National Land Cover Dataset; Landsat 7 ETM+; Imagery provided for Spring, Summer and Fall dates between 1999 and 2001:  
<http://gapanalysis.usgs.gov/gaplandcover/data/download/>

- USGS. (2003, October). Water Resources: Groundwater. (GIS Metadata) Retrieved August 2015, from <http://water.usgs.gov/ogw/aquifer/map.html>
- USGS. (2010). Geology: Surface Geology. (GIS Metadata) Retrieved April 2015, from <http://www.arcgis.com/home/item.html?id=2967ae2d1be14a8fbf5888b4ac75a01f>
- USGS. (2011). Geology: Landslide Incidence. (GIS Metadata) Retrieved May 2015, from Web service, data is not saved locally:  
<https://www.arcgis.com/home/item.html?id=b3fa4e3c494040b491485dbb7d038c8a>
- USGS. (2012). Cultural Resources: Physiographic Provinces. (GIS Metadata) Retrieved April 2015, from Physiographic provinces and regions are made from the same dataset; downloaded by state-level:  
[http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US\\_PhysiographicProvinces/FeatureServer](http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US_PhysiographicProvinces/FeatureServer)
- USGS. (2013). Geology: Karst Subsidence. (GIS Metadata) Retrieved May 2015, from Two data layers within the same source show different varieties of Karst, and were published on different dates:  
[http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian\\_Karst\\_Features/FeatureServer](http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian_Karst_Features/FeatureServer)
- USGS. (2014). Geology: Seismic Hazard. (GIS Metadata) Retrieved April 2015, from [http://services.arcgis.com/VTyQ9soqVukalItT/arcgis/rest/services/USPGA\\_Seismic\\_Hazard/FeatureServer](http://services.arcgis.com/VTyQ9soqVukalItT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer)
- USGS, Protected Areas of the United States. (2012, November 30). Land Use, Recreation, and Airspace: Land Ownership. (GIS Metadata) Retrieved August 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update:  
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Land Use, Recreation, and Airspace: Recreation. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:  
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Cultural Heritage. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:  
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). Visual Resources: Natural Areas. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update. :  
<http://gapanalysis.usgs.gov/padus/data/download/>



