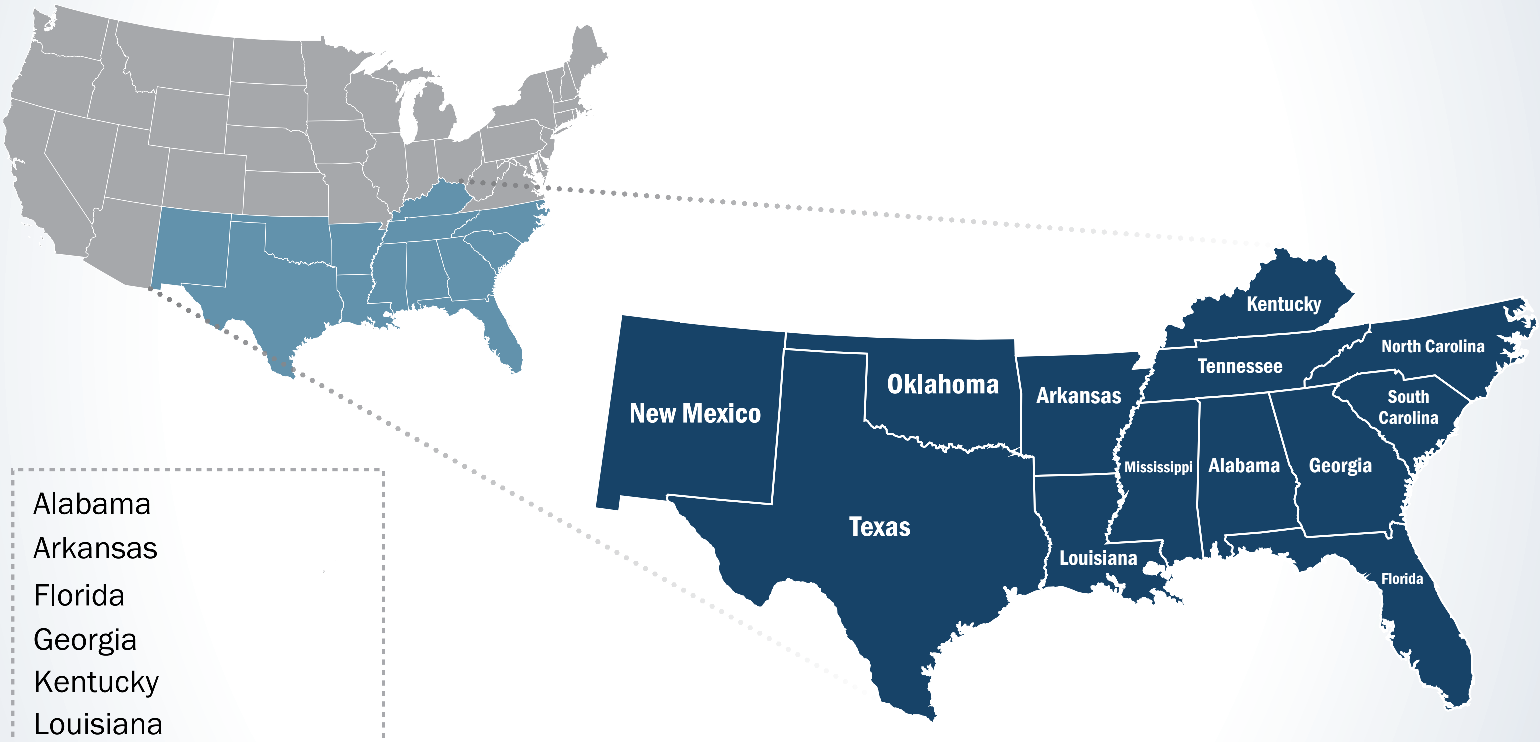
Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 13 - CHAPTER 15



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First Responder Network Authority

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Nationwide Public Safety Broadband Network

Final Programmatic Environmental Impact Statement for the Southern United States

VOLUME 13 - CHAPTER 15

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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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15. TEXAS

American Indian tribes with a rich cultural history lived in what is now the state of Texas for centuries before the 1500s. Texas was part of Mexico until 1836 when Texans declared their independence and formed the Republic of Texas, which successfully existed as a sovereign nation for almost a decade. Texas was annexed by the United States in 1844; in 1845, Congress approved the Texas Constitution and granted it statehood (Texas State Historical Association, 2015a). Texas is bordered by Oklahoma to the north, Arkansas and Louisiana to the east, the Gulf of Mexico and Mexico to the south, and New Mexico to the west. This chapter provides details about the existing environment of Texas as it relates to the Proposed Action.

General facts about Texas are provided below:

- **State Nickname:** The Lone Star State
- **Land Area:** 261,232 square miles; **U.S. Rank:** 2 (U.S. Census Bureau, 2015a)
- **Capital:** Austin
- **Counties:** 254 (Texas Comptroller, 2016)
- **2014 Estimated Population:** 26,956,958; **U.S. Rank:** 2 (U.S. Census Bureau, 2015a)
- **Most Populated Cites:** Houston, San Antonio, Dallas, and Austin (U.S. Census Bureau, 2015b)
- **Main Rivers:** Rio Grande, Red River, Brazos River, Colorado River, Canadian River, Guadalupe River, San Antonio River, Sabine River, Neches River, Trinity River, Pecos River, and Nueces River
- **Bordering Waterbodies:** Rio Grande, Sabine River, Red River, and the Gulf of Mexico
- **Mountain Ranges:** Chianti Mountains, Chalk Mountains, Glass Mountains, Davis Mountains, Apache Mountains, Delaware Mountains, Santiago Mountains, and Del Norte Mountains
- **Highest Point:** Guadalupe Peak (8,740 ft.) (USGS, 2015a)

15.1. AFFECTED ENVIRONMENT

15.1.1. Infrastructure

15.1.1.1. Introduction

This section provides information on key Texas 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 is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as "developed." Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports, harbors and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 15.1.1.3 provides an overview of Texas traffic and transportation infrastructure, including road and rail networks and waterway facilities. Texas public safety infrastructure could include any infrastructure utilized by a public safety entity[1] 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 Texas are presented in more detail in Section 15.1.1.4. Section 15.1.1.5 describes Texas' public safety communications infrastructure and commercial telecommunications infrastructure. An overview of District utilities, such as power, water, and sewer, is presented in Section 15.1.1.6.

15.1.1.2. Specific Regulatory Considerations

Multiple Texas laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 15.1.1-1 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.

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

Table 15.1.1-1: Relevant Texas Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Texas Statute (TS): Health and Safety Code Title 9 Safety: Texas Administrative Code (TAC): Title 37 Public Safety and Corrections	Texas Department of Public Safety, Division of Emergency Management	Coordinates the Emergency Management functions of the state.
TS: Utilities Code: TAC Title 16 Economic Regulation	Public Utility Commission of Texas	Regulates and supervises public utilities within the state.
TS: Transportation Code: TAC: Transportation	Texas Department of Transportation	Oversees the development and operation transportation systems of the state's highway, aeronautics, common carriers, marine, and other transportation facilities and services.

Source: (TX SOS, 2017a), (Texas Legislature, 2015), (TX SOS, 2017b), (TX SOS, 2017c)

15.1.1.3. Transportation

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

The Texas Department of Transportation (TxDOT) has jurisdiction over freeways and major roads, airports, railroads, and ports in the state; local counties have jurisdiction for smaller streets and roads. The mission of the TxDOT is to "work with others to provide safe and reliable transportation solutions for Texas" (TxDOT, 2015b).

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

- 313,228 miles of public roads (FHWA, 2014) and 52,937 bridges (FHWA, 2015a);
- 10,469 miles of rail network that includes passenger rail and freight (TxDOT, 2015c);
- 2,002 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 22 harbors (U.S. Harbors, 2015); and
- 15 ports, including 4 major ports (both public and private facilities) (TexasPorts, 2015).

Road Networks

As identified in Figure 15.1.1-1, the major urban centers of the state from north to south are Amarillo, Lubbock, Dallas-Fort Worth, El Paso, Austin, Houston, San Antonio, Laredo, and Brownsville (USDOC, 2013a). Texas has 11 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 15.1.1-2 lists the interstates and their start/end points in Texas. 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 15.1.1-2: Texas Interstates

Interstate	Southern or western terminus in TX	Northern or eastern terminus in TX
I-2	US-83 in Palmview	I-69E in Harlingen
I-10	NM line in Anthony	LA line in Orange
I-20	I-10 near Toyah	LA line near Waskom
I-27	US-87 in Lubbock	I-40 in Amarillo
I-30	I-20 in Fort Worth	AR line in Texarkana
I-35	US-83 in Laredo	OK line near Gainesville
I-37	US-181 in Corpus Christi	I-35 in San Antonio
I-40	NM line in Glenrio	OK line near Shamrock
I-44	US-277 in Wichita Falls	OK line in Burkburnett
I-45	Rt-87 in Galveston	I-30 in Dallas
I-69	US-59 in Rosenberg	US-59 in Cleveland

Source: (FHWA, 2015b)

TxDOT maintains 80,268 centerline miles of roadway (TxDOT, 2015d):

- Interstate highways: 3,272;
- U.S. Highways: 12,062;
- State Highways, Spurs, Loops, Business Routes: 16,411;
- Farm or Ranch to Market roads and Spurs: 40,932;
- Pass, Park and Recreation Roads: 345; and
- Frontage roads: 7,245.

Texas has neither National Scenic Byways nor 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).

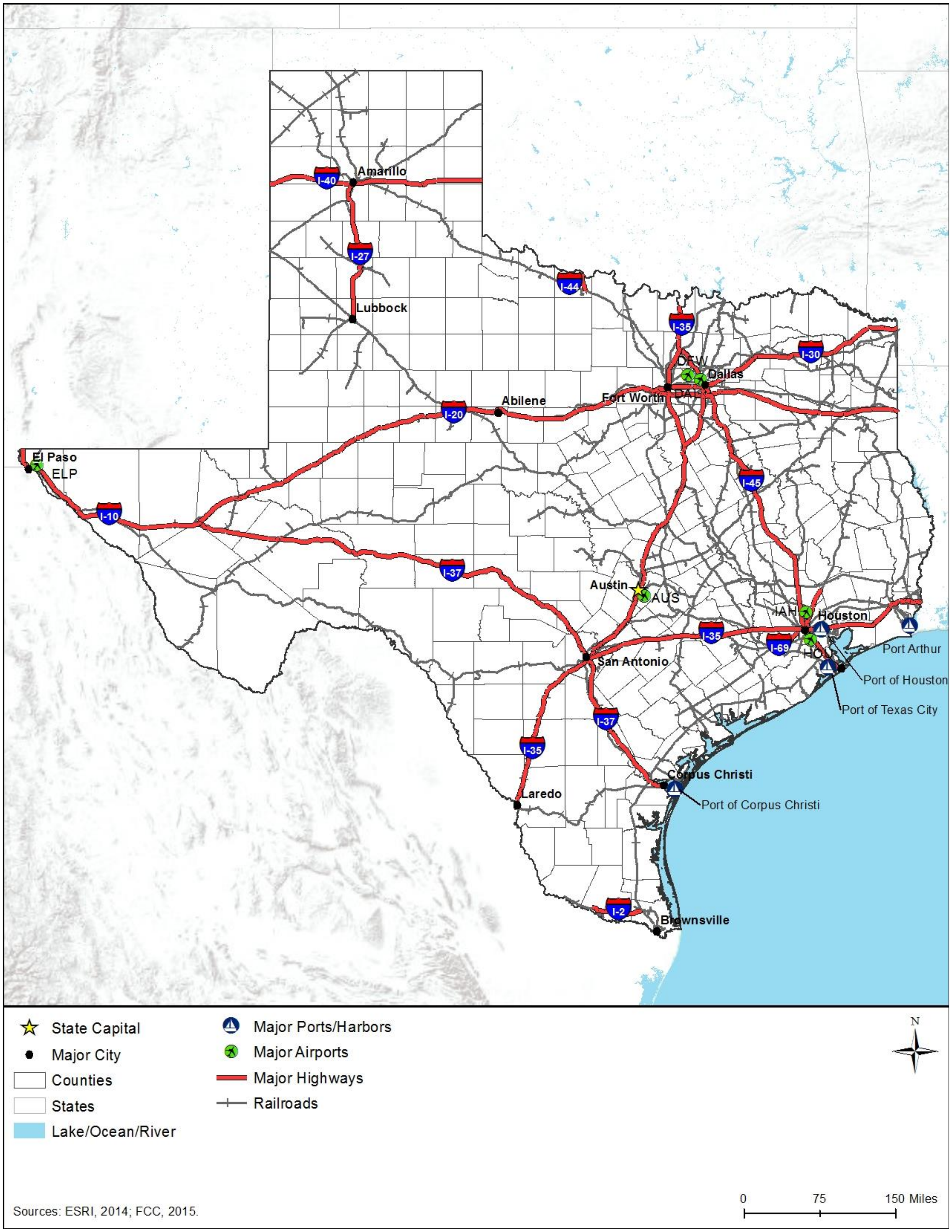


Figure 15.1.1-1: Texas Transportation Networks

Airports

Air service to the state is provided by several major airports. The three busiest airports in the state are:

- Dallas/Fort Worth International Airport (DFW) is located in between the Cities of Dallas and Fort Worth. In 2014, DFW served 63,520,359 passengers (DFW, 2014a), facilitated 679,820 aircraft operations (DFW, 2014b), and moved 700,185,900 pounds of cargo (DFW, 2014c). That same year, DFW was the 4th busiest airport in the nation in terms of the number of passengers served (FAA, 2015f) and the 10th busiest in the nation in terms of the amount of cargo moved (FAA, 2015g).
- George Bush Intercontinental/Houston Airport (IAH) is located 19 miles north of downtown Houston. In 2014, IAH served 41,251,015 passengers, facilitated 508,935 aircraft operations, and moved 461,491 metric tons of freight (HAS, 2014). That same year, IAH was the 11th busiest airport in the nation in terms of the number of passengers served (FAA, 2015f) and the 17th busiest in the nation in terms of the amount of cargo moved (FAA, 2015g).
- William P. Hobby Airport (HOU) is located seven miles southeast of downtown Houston. In 2014, HOU served 11,945,825 passengers, facilitated 193,647 aircraft operations, and moved 12,705 metric tons of freight (HAS, 2014). That same year, HOU was the 32nd busiest airport in the nation in terms of the number of passengers served (FAA, 2015f).

Other large airports in Texas include Austin-Bergstrom International Airport (AUS), Dallas Love Field (DAL), El Paso International Airport (ELP), and San Antonio International Airport (SAT). Figure 15.1.1-1 illustrates the major airports, in the state. Section 15.1.7, Land Use, Recreation and Airspace, provides greater detail on airports and airspace in Texas.

Rail Networks

Texas is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 15.1.1-1 illustrates the major rail lines in Texas.

Amtrak runs three lines through Texas: Heartland Flyer, Sunset Limited, and Texas Eagle. The Heartland Flyer runs every day between Oklahoma City and Fort Worth, making two stops in Texas. The Sunset Limited makes the trip between New Orleans and Los Angeles three times per week, with seven stops in Texas. The Texas Eagle runs daily between Chicago and San Antonio and 3 times per week from Chicago to Los Angeles with 16 stops in Texas. In 2014, Amtrak served more than 409,000 passengers in Texas (TxDOT, 2015c). Table 15.1.1-3 provides a complete list of Amtrak lines that run through Texas.

Table 15.1.1-3: Amtrak Train Routes Serving Texas

Route	Starting Point	Ending Point	Length of Trip	Major Cities Served in Texas
Heartland Flyer	Oklahoma City, OK	Fort Worth, TX	4 hours 14 minutes	Gainesville, Fort Worth
Sunset Limited	New Orleans, LA	Los Angeles, CA	48 hours	Beaumont, Houston, San Antonio, Del Rio, Sanderson, Alpine, El Paso
Texas Eagle	Chicago, IL	San Antonio, TX or Los Angeles, CA	32 hours 25 minutes (Chicago-San Antonio) 65 hours 20 minutes (Chicago-Los Angeles)	Dallas, Fort Worth, Austin, San Antonio, El Paso

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

Austin's Capital MetroRail commuter rail service during the week days between Leander and downtown Austin, with Saturday service between Lakeline and downtown Austin (Capital Metro, 2015). MetroRail serves 9 stations along its 32-mile line (Capital Metro, 2015). In 2014, MetroRail facilitated 795,400 rides, with an average of 66,000 trips per month (Capital Metro, 2014).

Dallas Area Rapid Transit (DART) provides public transit to Dallas and 12 neighboring cities (DART, 2015a). DART's rail services include DART Light Rail and the Trinity Railway Express (TRE). DART Light Rail serves Dallas and the surrounding suburbs of Carrollton, Farmers Branch, Garland, Irving, Plano, and Richardson (DART, 2015a); the system is 90 miles long with 62 stations (DART, 2015b). The TRE commuter rail provides service between Dallas and Fort Worth (DART, 2015a); the system is 34 miles long with 10 stations (DART, 2015b). In 2014, DART Light Rail facilitated 29.5 million passenger trips and TRE facilitated 2.3 million passenger trips (DART, 2015b).

Houston's MetroRail provides commuter rail service to downtown Houston and other populated areas of the city, including midtown, the Museum District, Moody Park, and the Texas Medical Center (Ride Metro, 2015). Houston's MetroRail's Red Line is 13 miles long with 25 stations; it currently carries an average of 48,000 passengers every day (Ride Metro, 2015). The Purple Line is 6.6 miles long with 10 stations (Ride Metro, 2015). The Green Line is currently under construction, but it will have nine stations once complete (Ride Metro, 2015).

With 10,469 miles of railroad track in the state, Texas has the highest number of rail miles in the nation (TxDOT, 2015c). Three Class I freight rail companies operate on 9,600 miles of track in Texas: BNSF Railway, Kansas City Southern, and Union Pacific Railroad (TxDOT, 2015e). In addition, 46 Class III railroads operate in the state on 1,823 miles of track (TxDOT, 2015c). In 2013, freight rail moved 403.3 million tons of freight; of that, over 180 million tons was inbound for Texas and over 60 million tons was outbound (TxDOT, 2015c). In 2014, 20 percent of all freight tonnage in Texas moved via freight rail (TxDOT, 2015c).

Harbors and Ports

Texas shares its large eastern coastline with the Gulf of Mexico. This area is lined with harbors, marinas, and an assortment of other maritime facilities. A total of 15 ports in the state belong to the Texas Ports Association, which seeks to "advance the development of Texas ports, enabling them to compete with ports outside Texas and thereby strengthen the economy of Texas" (TexasPorts, 2015). These facilities account for more than $82.8 billion (B) worth of value to the state, including the 1.4 million jobs that are involved in cargo handled through shipping terminals. As shown in Figure 15.1.1-1, the four major ports in the state are the ports of Houston, Port Arthur, Corpus Christi, and Texas City (TexasPorts, 2015).

The Port of Houston is located east of the city of Houston, on the banks of the Trinity Bay, Buffalo Bayou, and Tabbs Bay. The ports' terminals line the shores of the several bodies of water that comprise the Houston Ship Channel, which allows ships into the Buffalo Bayou (PortofHouston, 2015a). The Port of Houston is home to a 52-mile long shipping channel; which is 45 feet deep and 530 feet wide. The Channel's northern shore is occupied largely by ExxonMobil's Baytown Refinery, the country's largest oil refinery, while port terminals occupy the south shore (PortofHouston, 2015b). The port handles roughly 67 percent of all containerized cargo that moves through the Gulf of Mexico (PortofHouston, 2015c). This cargo includes machinery, automotive parts, fabric, resins and plastics, and a host of other commodities (PortofHouston, 2015d). Rail services at the Port of Houston are operated by BNSF, Union Pacific, and Port Terminal Rail Association rail lines. The Barbours Cut terminal offers an intermodal rail ramp that leads directly to terminal warehouses, making storage of containers easier (PortofHouston, 2015e). In 2013, the Port of Houston imported $74.3B worth of cargo, weighing 77.6 million tons; and exported $94B, weighing 85.4 million tons (U.S. Census Bureau, 2015c).

Port Arthur is located in eastern Texas, near the border with Louisiana. It can be found along the banks of the Sabine-Neches Ship Canal, which runs between St. Marks, Florida and Brownville, Texas. The port is only 19 miles from the Gulf, allowing easy access for international freighters (PortofPortArthur, 2015a). Port Arthur handles a large number of products, including wood pulp, lumber, heavy metals, dry bulk cargo, and military cargo (PortofPortArthur, 2015b). Railroad service is provided by Kansas City Southern Railroad, though there are nearby connections with Norfolk Southern Railroad, as well as UP Railroad and BNSF Railroad in the United States. Overland shipping to Mexico can be accomplished through Tex Mex and Transportacion Ferroviaria Mexicana (TFM) Railroads (PortofPortArthur, 2015c). In 2013, Port Arthur imported cargo worth approximately $29B and weighing 44.7 million tons, and exported $8.2B in cargo, weighing 16.7 million tons (U.S. Census Bureau, 2015c).

The Port of Corpus Christi can be found in mid-eastern Texas on Corpus Christi Bay. There are facilities on the both the southern and northern shores of the bay, as well as on the southern shore of the nearby Nueces Bay. A shipping channel separates from Nueces Bay facilities from the mainland (PortofCC, 2015a). The Port of Corpus Christi's terminals dot a wide area around the Nueces and Corpus Christi Bays. The ports facilities on the south side of the Nueces Bay are served by rail lines from Kansas City Company, BNSF Railway and UP (PortofCC, 2015b). In

2014, the ports' most frequent cargo included crude oil, feed stock, benzene, bauxite ore, and fuel oil (PortofCC, 2015c). In 2013, Corpus Christi imported $14.7B worth of cargo, weighing 24.5 billion kg; while exporting $10.5B, weighing 16.1 million tons (U.S. Census Bureau, 2015c).

The Port of Texas City is located on the Galveston Bay in the center of the Texas coastline. It is just southeast of the City of Houston, and is partially sheltered weather by the Texas City Dike (TCTRR, 2015a). The Port of Texas City is a privately owned facility, owned by the Texas City Terminal Railway Company. In addition to the rail service provided by the Texas City Railway, services are also provided by UP Railroad and BNSF Railway (TCTRR, 2015b). This facility was responsible for importing $10B weighing 15.4 million tons in 2013, and exporting $9.7B, weighing 12.3 million tons (U.S. Census Bureau, 2015c).

15.1.1.4. Public Safety Services

Texas public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 15.1.1-4 presents Texas' key demographics including population; land area; population density; and municipal governments. More information about these demographics is presented in Section 15.1.9, Socioeconomics.

Table 15.1.1-4: Key Texas Indicators

Texas Indicators	
Estimated Population (2014)	26,956,958
Land Area (square miles) (2010)	261,232
Population Density (persons per sq. mile) (2014)	103
Municipal Governments (2013)	1,209

Sources: (National League of Cities, 2007), (U.S. Census Bureau, 2014; U.S. Census Bureau, 2010a)

Table 15.1.1-5 presents Texas' public safety infrastructure, including fire and police stations. Table 15.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and medical personnel in the state.

Table 15.1.1-5: Public Safety Infrastructure in Texas by Type

Infrastructure Type	Number
Fire and Rescue Stations[a]	2,850
Law Enforcement Agencies[b]	2,955
Fire Departments[c]	1,528

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

[a] Data collected by the U.S. Fire Administration in 2015.
[b] Number of agencies from state and local law enforcement include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.
[c] Data collected by the U.S. Fire Administration in 2015.

Table 15.1.1-6: First Responder Personnel in Texas by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers[a]	7,820
Fire and Rescue Personnel[b]	60,304
Law Enforcement Personnel[c]	170,891
Emergency Medical Technicians and Paramedics[d, e]	18,270

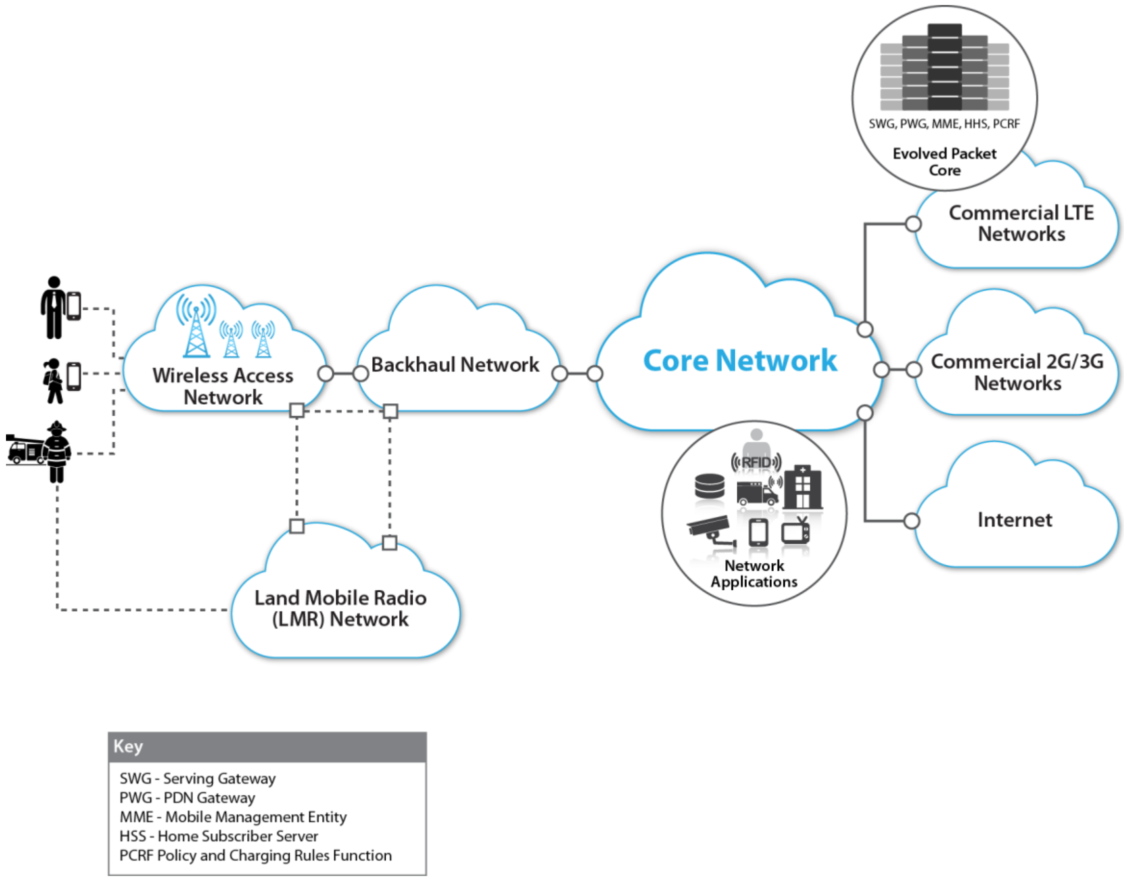
Sources: (U.S. Fire Administration, 2015) (U.S. Bureau of Justice Statistics, 2011) (BLS, 2015a)

[a] BLS Occupation Code: 43-5031.
[b] BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters reported by the U.S. Fire Administration.
[c] Full-time employees from state and local law enforcement agencies which include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.
[d] BLS Occupation Code: 29-2041.
[e] All BLS data collected in 2015.

15.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Texas; 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 15.1.1-2 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 15.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would likely make their work safer and more efficient. Designing such a network presents several challenges due to the uniqueness of the deployment, the requirements, and the nationwide scale (NIST, 2015). Historically, there have been many challenges and impediments to timely and effective sharing of information. Chief among these factors impacting information sharing are: network coverage gaps, land mobile radio system infrastructure diversity, insufficient budgets, and diverse radio frequencies.

Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and specifically in Texas. 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 to better inform investment decisions (PSCR, 2015).

Like most states, Texas' public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities and integration to achieve its vision of increased interoperability across the large number of diverse regional systems in the state. According to the state's Statewide Communication Interoperability Plan (SCIP) Texas' vison for public safety voice communications is to implement a "systems of system" approach to support public safety voice communications through the coordinated use of multiple frequencies and regional communications infrastructure assets located throughout the state (Texas DPS, 2013).

Texas is focused longer-term on achieving its goals in LMR voice and broadband public safety data via deployment of a statewide, cross-channel, voice LMR system, as well as deploying Long-term Evolution (LTE) 700 MHz for data, video, and multimedia applications. In its SCIP Texas summarized this approach as follows, "The long-range goal for the State is to create a statewide, fully interoperable voice communications system-of-systems. This hybrid system will be multi-band, shared, and standards-based. Components will include Very High Frequency (VHF)[2]/700/800 Megahertz (MHz) Project-25 standards-based trunked and conventional systems, TSICP [Texas State Interoperability Channel Plan] programmed radios, and high-level network connections to regional and existing systems" (Texas DPS, 2013).

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

Texas is home to one of the "early builder" public safety LTE 700 MHz projects (in Harris County) that FirstNet is looking to with "lessons learned" approach in advance of the deployment of the broadband National Public Safety Broadband Network (NPSBN) (Bratcher, 2015). The Harris County 700 MHz project is a 14 tower site project with 13 sites in the Harris County service area, and one site in Brazos County, to enable an extended range coverage evaluation (Jennings, 2007).

The Public Safety Communications Group within the Department of Public Safety (DPS) has 27 communications facilities throughout the state and provides support for a wide variety of wireless special projects, as well as support for interoperability wireless infrastructure (Texas DPS, 2015).

Statewide/Multi-County Public Safety Networks

Because of Texas' very large land mass, diversity in county community types (from urban through rural), presence of multiple large metropolitan areas, and the large number of diverse legacy LMR networks and systems, the state has organized around 24 Councils of Government (COGs) which supports the state's LMR "system of systems" approach. Figure 15.1.1-3 depicts this regional structure which provides a mechanism for county and city entities, to both plan and oversee participation in state shared LMR systems. In addition, the COGs contribute to the advancement of greater interoperability across disparate LMR frequencies (Texas DPS, 2013).

This regional structure is an essential enabler in facilitating the planning, budgeting, and technical interworking of the diverse LMR systems in the state as it enables cross-agency and cross-geography public safety communications through technologies such as Radio over Internet Protocol (RoIP), digital P25, and the use of central controllers in LMR systems (Texas DPS, 2013). All of these systems are in wide use in Texas.

To implement its regional "system of systems" public safety approach, Texas has engaged key state agencies such as DPS, Texas Department of Transportation (TxDOT), and Texas Parks & Wildlife Development (TPWD), as well as local organizations, in order to operate on a number of the Regional Radio Systems (RRS) (Texas DPS, 2013). A key example of this agency/partnership model of the RRS can be seen with TxDOT, which is partnered with Austin/Travis County. Harris County, the DFW overlay system as well as the Conch valley systems to enhance interoperability (Texas DPS, 2013).

#	Region Name
18	Alamo Area Council of Governments
5	Ark-Tex Council of Governments
13	Brazos Valley Council of Governments
12	Capitol Area Council of Governments
23	Central Texas Council of Governments
20	Coastal Bend Council of Governments
10	Concho Valley Council of Governments
14	Deep East Texas Council of Governments
6	East Texas Council of Governments
17	Golden Crescent Regional Planning Commission
11	Heart of Texas Council of Governments
16	Houston-Galveston Area Council
21	Lower Rio Grande Valley Development Council
24	Middle Rio Grande Development Council
3	Nortex Regional Planning Commission
4	North Central Texas Council of Governments
1	Panhandle Regional Planning Commission
9	Permian Basin Regional Planning Commission
8	Rio Grande Council of Governments
15	South East Texas Regional Planning Commission
2	South Plains Association of Governments
19	South Texas Development Council
22	Texoma Council of Governments
7	West Central Texas Council of Governments

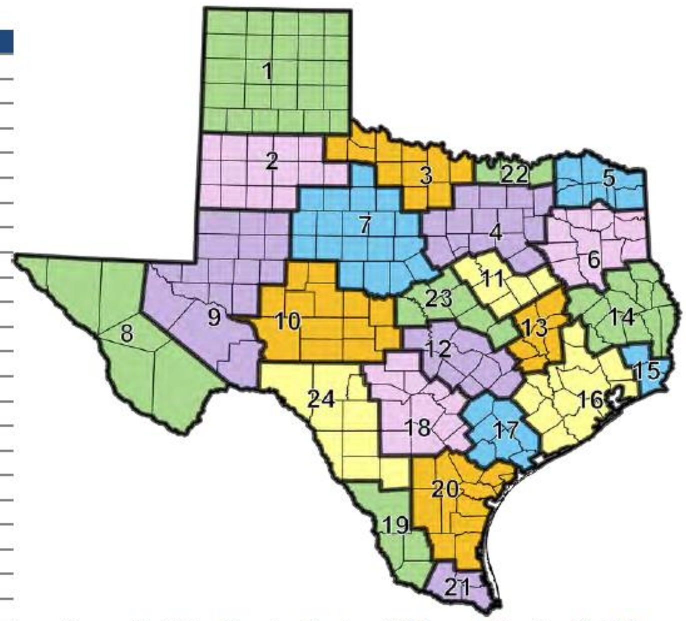


Figure 13: State Planning Regions/COGs and Disaster District Boundaries

Source: (Texas DPS, 2013)

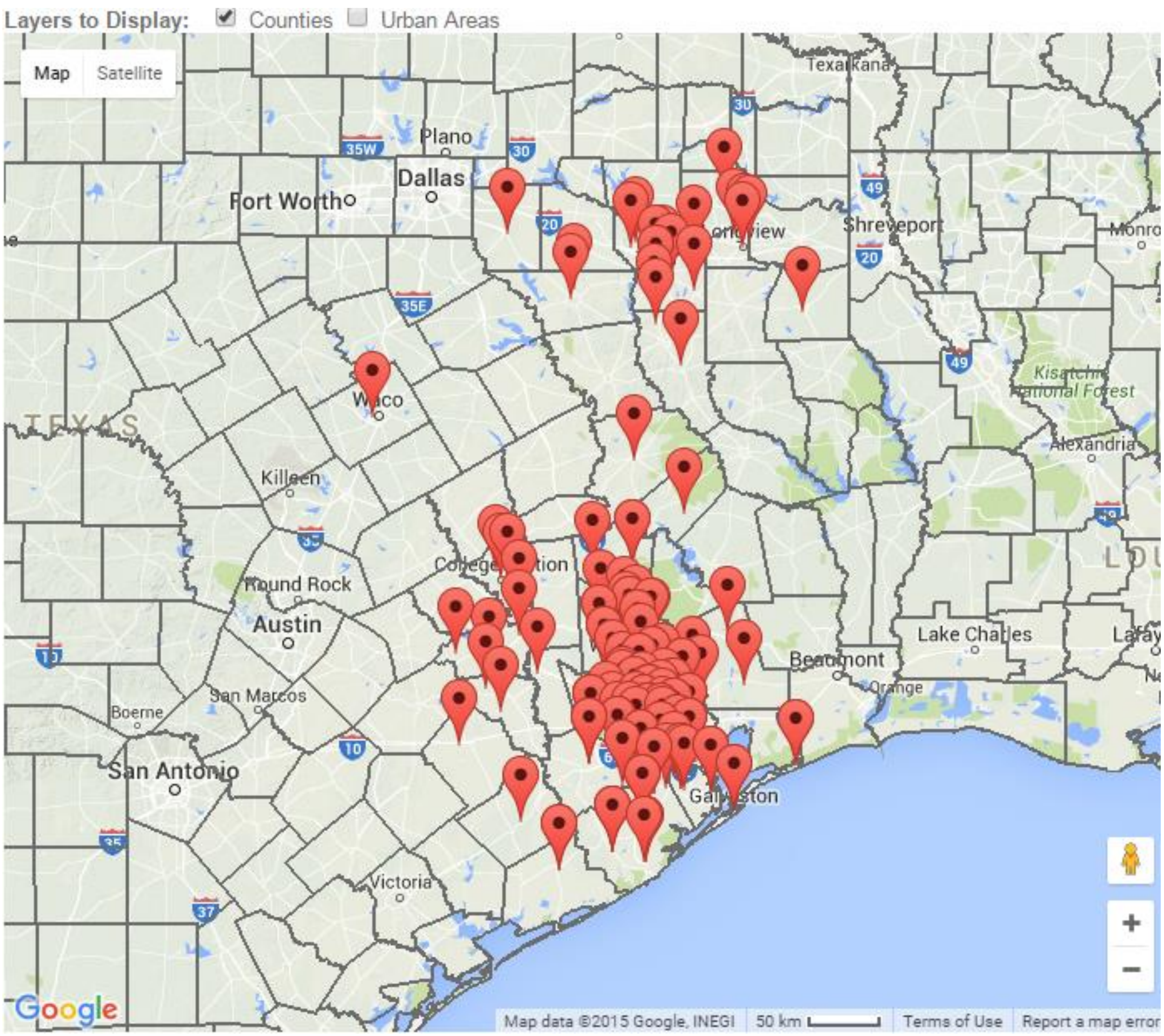
Figure 15.1.1-3: Texas Regional Planning/Council of Government Regional Structure

Three examples of the major state and multi-county LMR systems in Texas are: (1) The Lower Colorado River Authority (LCRA) operating 900 MHz proprietary system, as well as a 700 MHz P25 overlay system with total coverage of 60 central Texas counties; (2) DPS's VHF P25 narrowband and Internet Protocol (IP) gateway network that allows for interconnection across multiple discrete state agency and local public safety departments; and (3) TxDOT's statewide VHF analog narrowband and digital P25 VHF/700 MHz/800MHz/900MHz IP gateway interconnection infrastructure that provides cross-agency regional communications (Texas DPS, 2013).

A key example of Texas' commitment to LMR modernization and multi-county/regional coverage is the Texas digital P25 Texas Wide Area Radio Network (TxWARN) which operates at 700 MHz and 800 MHz, and is supported by the radio tower site network depicted in Figure 15.1.1-4 below. TxWARN covers 31 counties within the state (RadioReference.com, 2015).

County/City Public Safety Networks

In Texas, county and local public safety communications have been supported by a diverse set of systems and frequencies including VHF, Ultra High Frequency (UHF),[3] 700 MHz, 800 MHz, and 900 MHz across the state's counties and cities. There continues to be high diversity in the types and frequencies of LMR systems adopted by county and local public safety departments, but Texas has implemented a shared radio systems approach based on RoIP, as well as the use of IP gateways to interconnect disparate systems, and promote greater interoperability across the state (Texas DPS, 2013).



Source: (RadioReference.com, 2015)

Figure 15.1.1-4: P25 TxWARN Tower Site Locations

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

Reflecting the commitment to a shared "system of systems" approach to address the state's LMR public safety and interoperability needs, is the large number of regional and multi-county digital P25 systems in the state; as Table 15.1.1-7 illustrates (Texas DPS, 2013). There are 43 public safety digital P25 systems operational in Texas, and Table 15.1.1-7 below lists these LMR systems and their operating frequencies. All three systems operate on 800 MHz, thereby facilitating interoperability across these systems (Project 25.org, 2015a) (Project 25.org, 2015b).

Public Safety Answering Points

According to the Federal Communication Commission's (FCC) Master PSAP registry, there are 635 PSAPs in Texas serving Texas' 254 counties.

Table 15.1.1-7: Texas Public Safety P25 Networks

Texas P25 Public Safety Systems	Frequency Band
Arkansas Wireless Information Network (AWIN)	700 MHz/800 MHz
Bell County Public Safety (P25) System	700 MHz
Concho Valley County of Governments	VHF
El Paso P25 Regional Communications System	700 MHz/800 MHz
Grant Prairie P25	800 MHz
Greater Austin/Travis Regional Radio System	VHF/700 MHz//800 MHz
Hurst P25	700 MHz/800 MHz
Jackson County public Services	700 MHz
Lacy-Lakeview Public Services System	VHF
Laredo Public Safety	800 MHz
Lower Colorado River Authority (LCRA) P25	700 MHz/800 MHz
Lower Rio Grande Valley Regional Radio System	700 MHz/800MHz
Pantex	UHF Lo
Parker County (Project 25)	VHF/700 MHz
Permian Basin Regional Interoperability Network	VHF/800 MHz
Pharr/Edinburg Public Safety (Project25)	800 MHz
Prosper Public Safety	800 MHz
Richardson P25	800 MHz
San Antonio Urban Area Initiative Overlay	700 MHz
Southeast Texas Regional Radio System (SETRRS)	800 MHz
Richardson P25	800 MHz
San Antonio Urban Area Initiative Overlay	700 MHz
Southeast Texas Regional Radio System (SETRRS)	800 MHz
Terrell P25	700 MHz
Victoria (Project25)	800 MHz
White Settlement P25	800 MHz
Woodway P25	VHF
Ysleta Del Sur Pueblo	800 MHz
Carrolton Public Safety	800 MHz
Coastal Bend Regional Public Safety Network	700 MHz
White Settlement P25	800 MHz
Cy-Fair Volunteer Fire Department	700 MHz
Dallas/North Central Council of Texas Governments (NCTCOG)	700 MHz
DFW Airport Authority/NCTCOG	700 MHz
Fourney-Kaufman County	700 MHz
Fort Worth Regional Radio System	700 MHz/800 MHz
FRISCO-Collin County	800 MHz

Texas P25 Public Safety Systems	Frequency Band
Lubbock City-County Mutual Radio System	800 MHz
McKinney P25-Collin County	800 MHz
Montgomery County TX	800 MHz
Plano, Allen, Wylie, Murphy (PAWM)	800 MHz
Texas Wide Area Radio Network (Tx WARN)	700 MHz/800 MHz
Waco Public Safety- McLennan County	800 MHz

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

Commercial Telecommunications Infrastructure

Texas' 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 Texas' 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

Texas' 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 15.1.1-8 presents the number of providers of switched access[4] lines, Internet access,[5] and mobile wireless services including coverage.

Table 15.1.1-8: Telecommunications Access Providers and Coverage in Texas as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines [a]	274	97.7% of households [b]
Internet access [c]	169	56% of households
Mobile wireless [d]	15	95% of population

Sources: (FCC, 2014a) (FCC, 2014b) (FCC, 2013) (NTIA, 2014)

[a] Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 as the total of ILEC and non-ILEC providers (FCC, 2014b).
[b] Household coverage data provided by the FCC in "Universal Service Monitoring Report" as a Voice Penetration percentage (percentage of household with a telephone in the unit) and is current as of 2013.
[c] Internet access providers are presented in Table 21 by technology provided; the number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers. Household coverage is provided in Table 13 (FCC, 2014a).
[d] Mobile wireless provider data was retrieved from the FCC National Broadband Map website (www.broadbandmap.gov/data-download). The process of the data collection is explained in the broadband footnote.

[4] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services (POTS)" (FCC, 2014b).
[5] Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

Figure 15.1.1-9 shows the wireless providers in Texas along with their geographic coverage. The following five maps Figure 15.1.1-5 to Figure 15.1.1-9 show: the combined coverage for the top two providers; Sprint and T-Mobile's coverage; ERF Wireless, Cricket Wireless, and Skybeam's coverage; Transworld Network Corp., Ranch Wireless, MetroPCS Wireless Corp, Transworld Network Corp., and Big Bend Telephone Company's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 15.1.1-9: Wireless Telecommunications Coverage by Providers in Texas

Wireless Telecommunications Providers	Coverage
AT&T Mobility LLC	95.94%
Verizon Wireless	79.60%
Sprint	58.77%
T-Mobile	35.25%
Cricket Wireless	13.36%
ERF Wireless	11.87%
Skybeam	10.54%
MetroPCS Wireless, Inc.	8.14%
Transworld Network, Corp.	7.94%
Ranch Wireless	7.73%
Big Bend Telephone Company	6.85%
Other[a]	45.35%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: AMA Communications LLC; U.S. Cellular; West Central Net; GVEC.net; GHz Wireless; WesTex Connect Internet Services; Gtek Computers and Wireless; Argon Technologies; TierOne Networks; TISD, Inc.; VRFuturenet; Skynet Communications; Rock Solid Internet & Telephone; Texas Wireless Internet; VTX Communications, LLC; Texas Broadband, Inc.; Texas Communications; Internet America, Inc.; NextLink Broadband; Rural Texas Broadband; Texas Communications of San Angelo, Inc.; Rioplex Wireless; Texas Communications of Bryan, Inc.; Phoenix Broadband, LLC; Zipnet.us; Central Texas Communications, Inc.; NetWest Online, Inc.; Southwest Texas Telephone Company; Skynet Country, LLC; TGM Pinnacle Network Solutions; Poka Lambro Telecommunications; Border to Border Communications, Inc.; Farm to Market Broadband; Zulu Internet, Inc.; Digital Passage, Inc.; Evolve Broadband; Reach Broadband; Basin Broadband, Inc.; SOS Communications; the SPECnet; East Texas WiFi; PTCI; Central Link Broadband; ZipLink Internet.com; AwesomeNet; Speed of Light Broadband; Zochnet; East Texas DSL; Peoples Wireless; OneSource Communications; Western Broadband; Basin 2 Way; Bee Creek Communications, Inc.; Ridgewood Cable; Twin Wireless, Inc.; Nortex Communications; Texas CellNet; IguanaNet; Gecko Inter.Net; New Source Broadband; Web-Access; TXOL Internet Inc.; Smithville.net; Air Net, LLC; Amarillo Wireless; Hallettsville Communications; Broadwaves; Communications Etc.; Wharton County Electric Cooperative, Inc.; LiveAir Networks; ECTISP, Inc.; GOCO Wireless, Inc.; Cascom; Deep East Texas Communications; CG Communications, Inc.; Texhoma Wireless; PTCI; Alamo Broadband, Inc.; Zeecon Wireless Internet, LLC; Rodzoo Wireless; Gower Net; SmartBurst, LLC; DCTexas Internet; Starnet Online Systems; Cap Rock Telephone Cooperative; Broadcomm.Us; CKS Wireless; Digitex.com; TetCoBiz; Totelcom Communications, LLC; rNetworks Wireless Broadband; GoZoe Wireless, LLP; Echo Wireless Broadband; MEXUS; Our-Town Internet Services; Airplexus, Inc.; Balatize Broadband Services; TexasData; Santa Rosa Telephone Cooperative, Inc.; MobiNet, LLC; Hometown Computing; CCWIP; Dell Telephone Cooperative, Inc.; Leaco Wireless, LLC; Cybercom Corporation; TekWav; WaveDirect Telecommunications LLC; Colorado Valley Communications, Inc.; NDemand; CPUonsite; Indian Creek Internet Services, Inc.; Hillcountry Networks; LVWifi.com; Los Guys Wireless; Anvil Communications; Hill Country Telecommunications, LLC; Prompt Technology; East Texas Broadband; Mountain Zone TV Systems; VOWnet; MVC Wireless; SmartCom; Alenco Communications, Inc.; Aledo Broadband Brazos WiFi; Local Choice Internet; Wavelinx; Blossom Communications; Pathwayz Communications; and Mediastream.

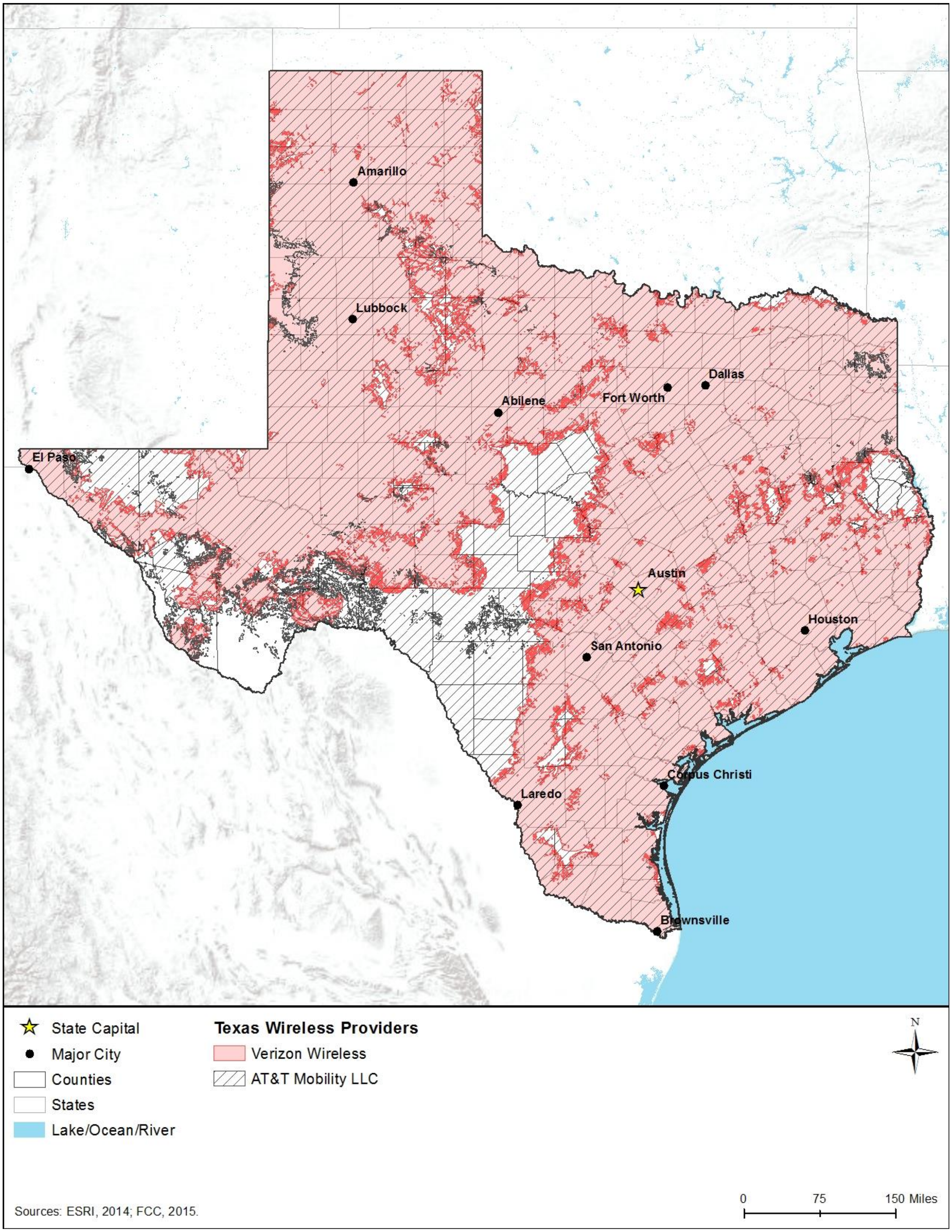


Figure 15.1.1-5: Top Wireless Providers Availability in Texas

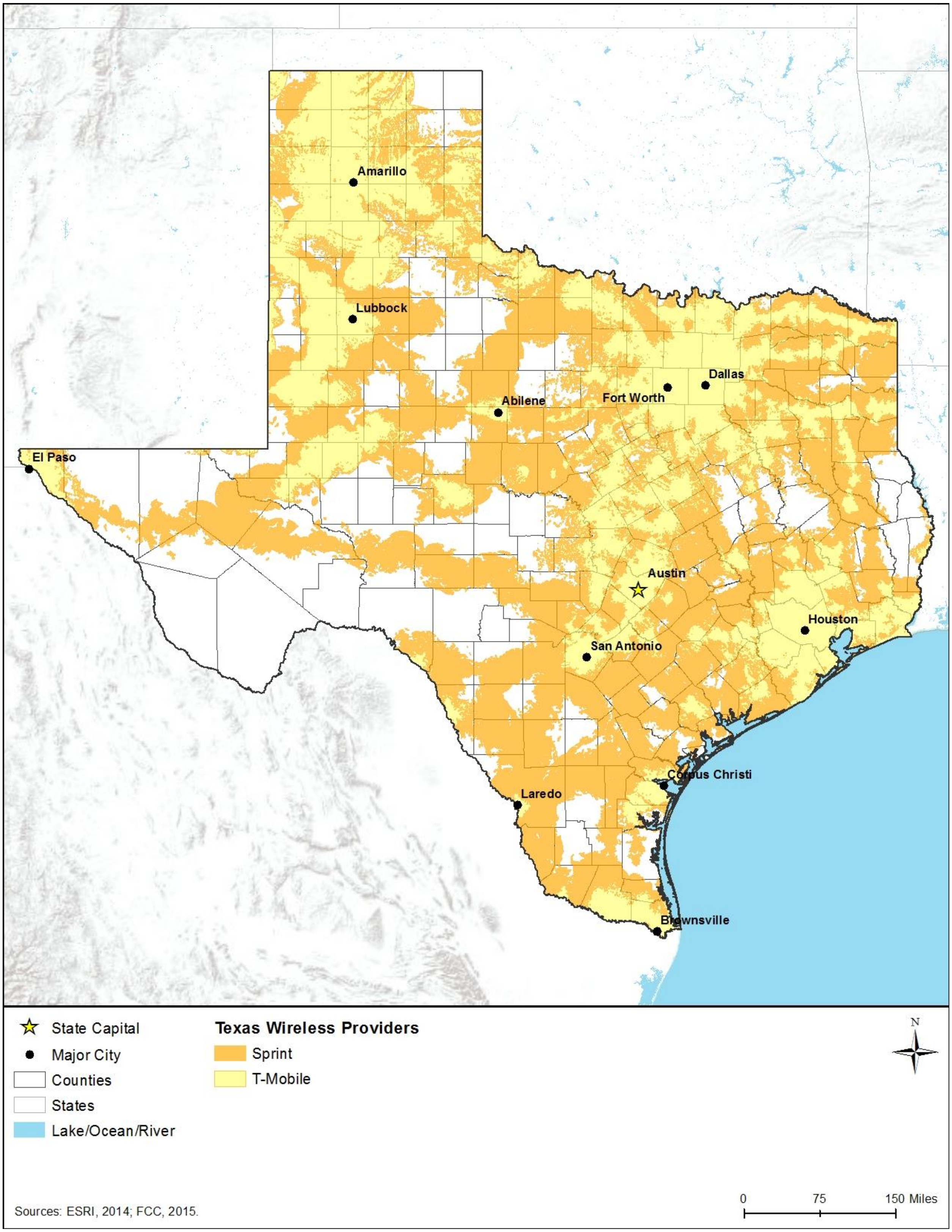


Figure 15.1.1-6: Sprint and T-Mobile Wireless Availability in Texas

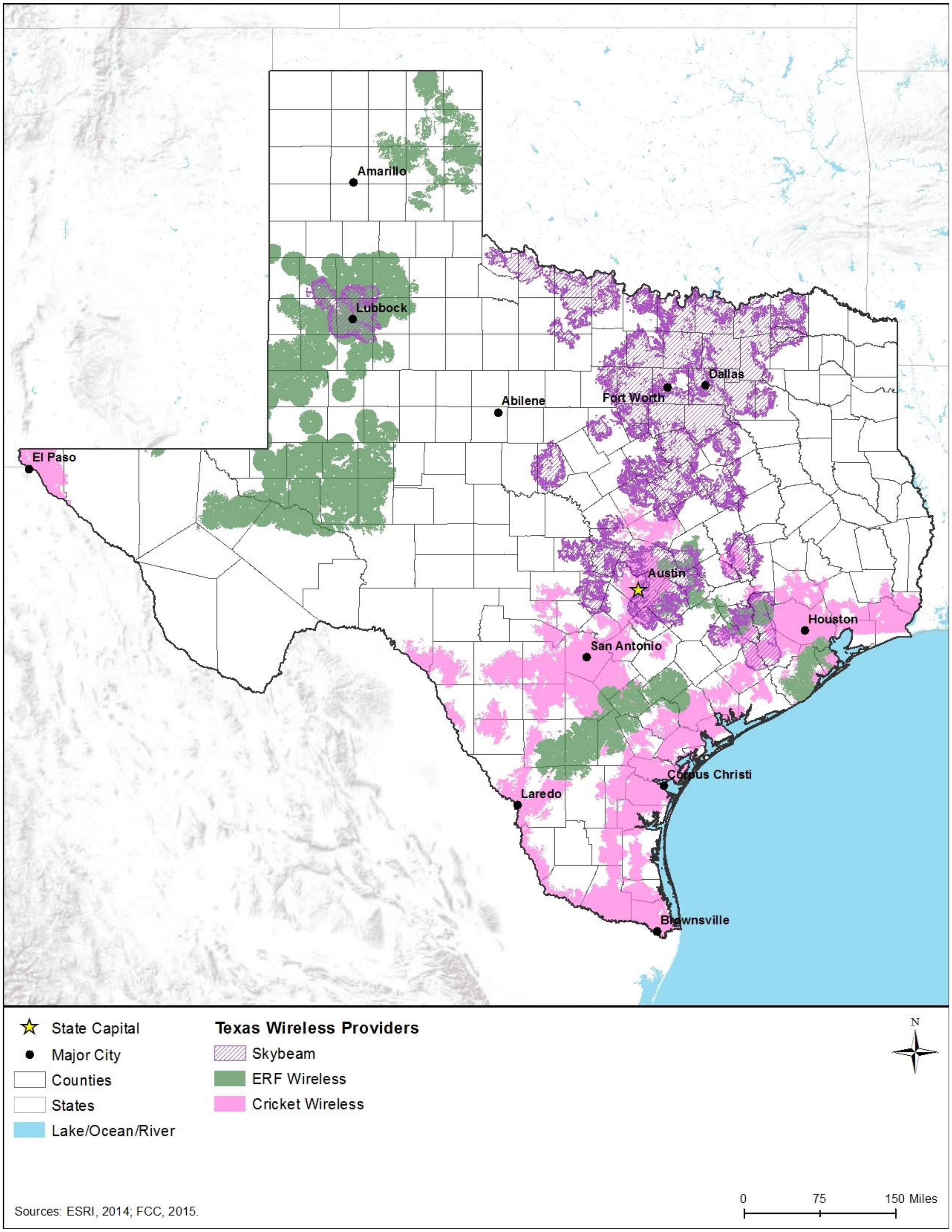


Figure 15.1.1-7: Cricket Wireless, ERF Wireless, and Skybeam Availability in Texas

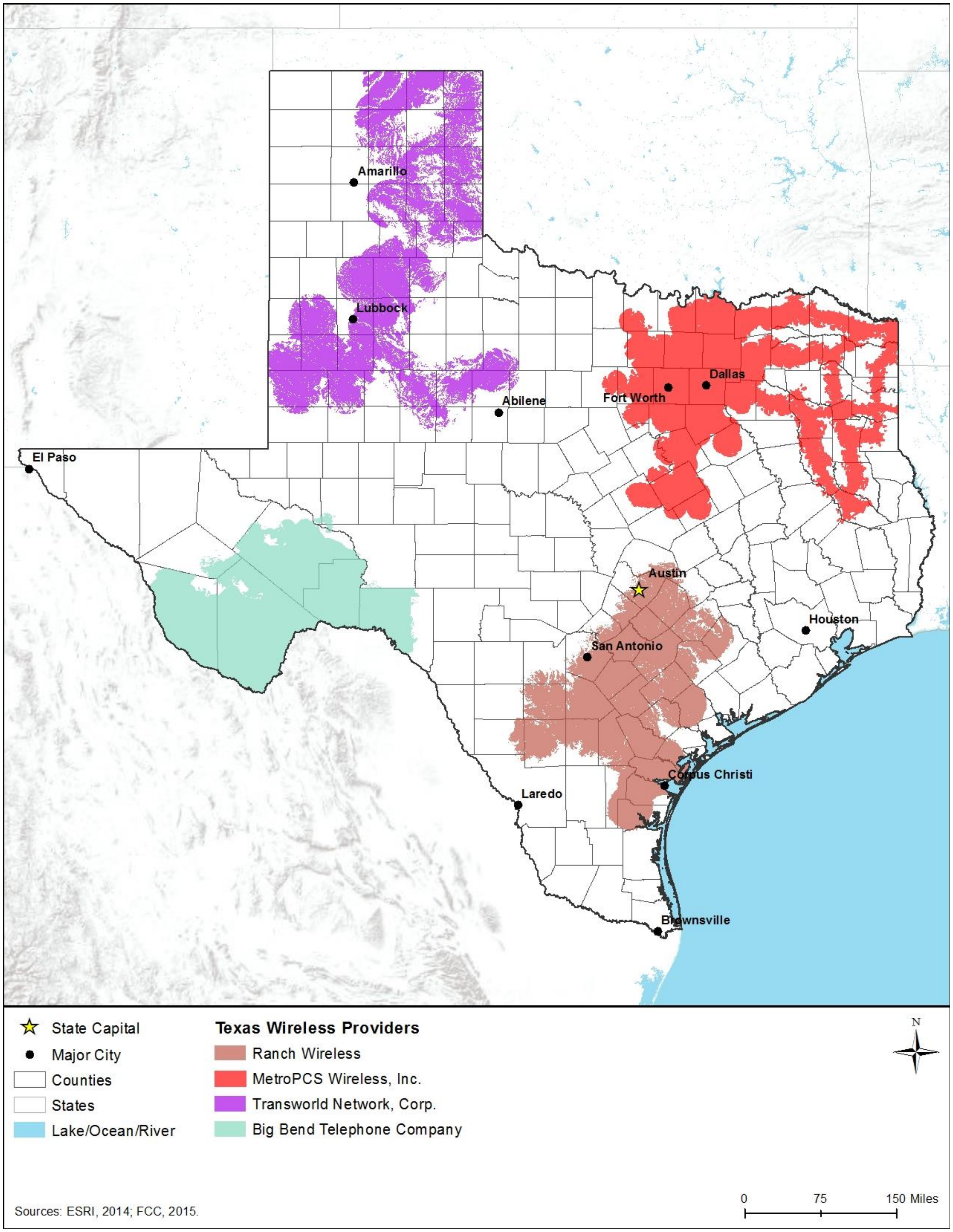


Figure 15.1.1-8: Ranch Wireless, Metro PCS, Transworld Network Corp, and Big Bend Telephone Company Wireless Availability in Texas

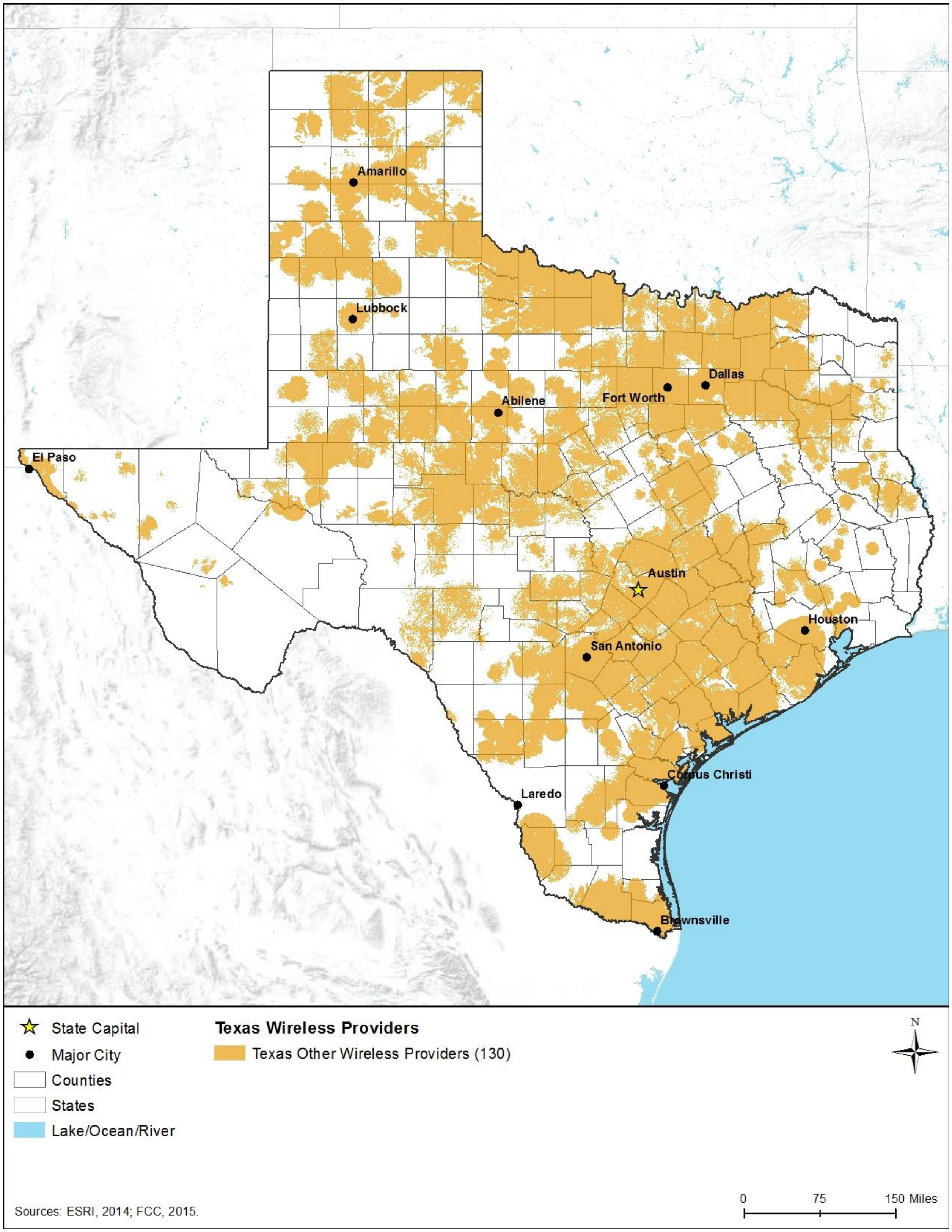


Figure 15.1.1-9: Other Providers Wireless Availability in Texas

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, 2009). Figure 15.1.1-10 presents representative examples of each of these categories or types of towers.

Monopole
100 – 200 feet
Source: http://laps.noaa.gov/birk/laps_intranet/site_photos/Monarch/tower.jpg

Lattice
200 – 400 feet
Source: Personal Picture

Guyed
200 – 2,000 feet
Source: http://www.esrl.noaa.gov/gmd/ccgg/insitu/

Figure 15.1.1-10: Types of Towers

Telecommunications tower infrastructure can be found throughout Texas, although tower infrastructure is concentrated in the higher and more densely populated areas of Texas; Amarillo, Lubbock, El Paso, Abilene, Fort Worth, Dallas, Austin, San Antonio, Houston, Laredo, Corpus Christi, and Brownsville. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[6] Table 15.1.1-10 presents the number of towers (including broadcast towers) registered with the FCC in Texas, by tower type, and Figure 15.1.1-11 presents the location of those 9.964 structures, as of June 2016.

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

Table 15.1.1-10: Number of Commercial Towers in Texas by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft.and over	2,057	100ft.and over	1
75ft.– 100ft	2,818	75ft.– 100ft	4
50ft.– 75ft	1,616	50ft.– 75ft	72
25ft.– 50ft	1,340	25ft.– 50ft	300
25ft.and below	326	25ft.and below	57
Subtotal	**8,175**	**Subtotal**	**434**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft.and over	479	100ft.and over	12
75ft.– 100ft	301	75ft.– 100ft	9
50ft.– 75ft	66	50ft.– 75ft	9
25ft.– 50ft	11	25ft.– 50ft	7
25ft.and below	3	25ft.and below	4
Subtotal	**840**	**Subtotal**	**41**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft.and over	49	100ft.and over	2
75ft.– 100ft	267	75ft.– 100ft	4
50ft.– 75ft	228	50ft.– 75ft	2
25ft.– 50ft	99	25ft.– 50ft	0
25ft.and below	25	25ft.and below	0
Subtotal	**430**	**Subtotal**	**8**
Constructed Tanks[d]			
Tanks	36		
Subtotal	**36**		
Total All Tower Structures		**9,964**	

Source: (FCC, 2015)

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

[b] Self standing or guyed (anchored) structure used for communication purposes (FCC, 2012).

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

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

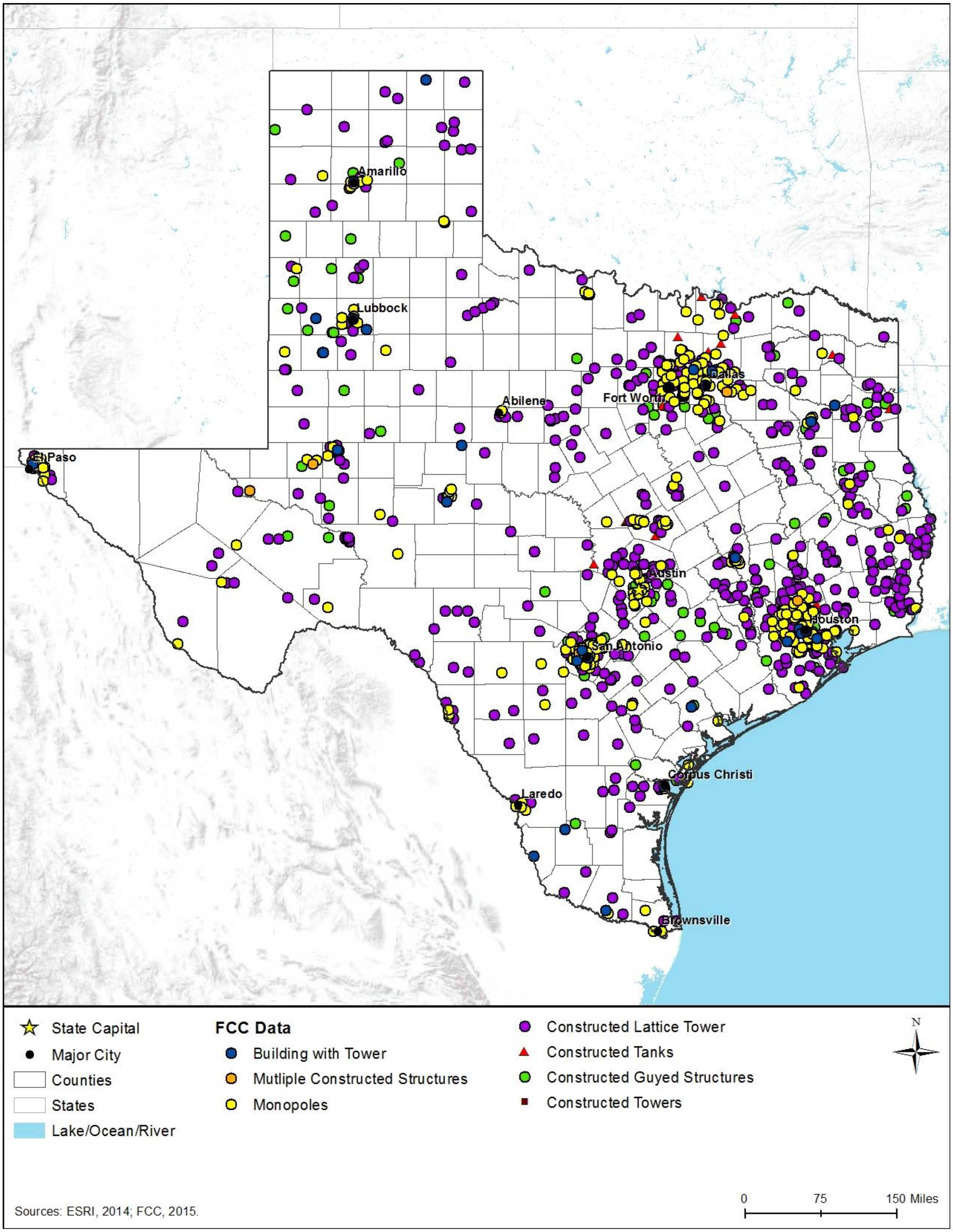
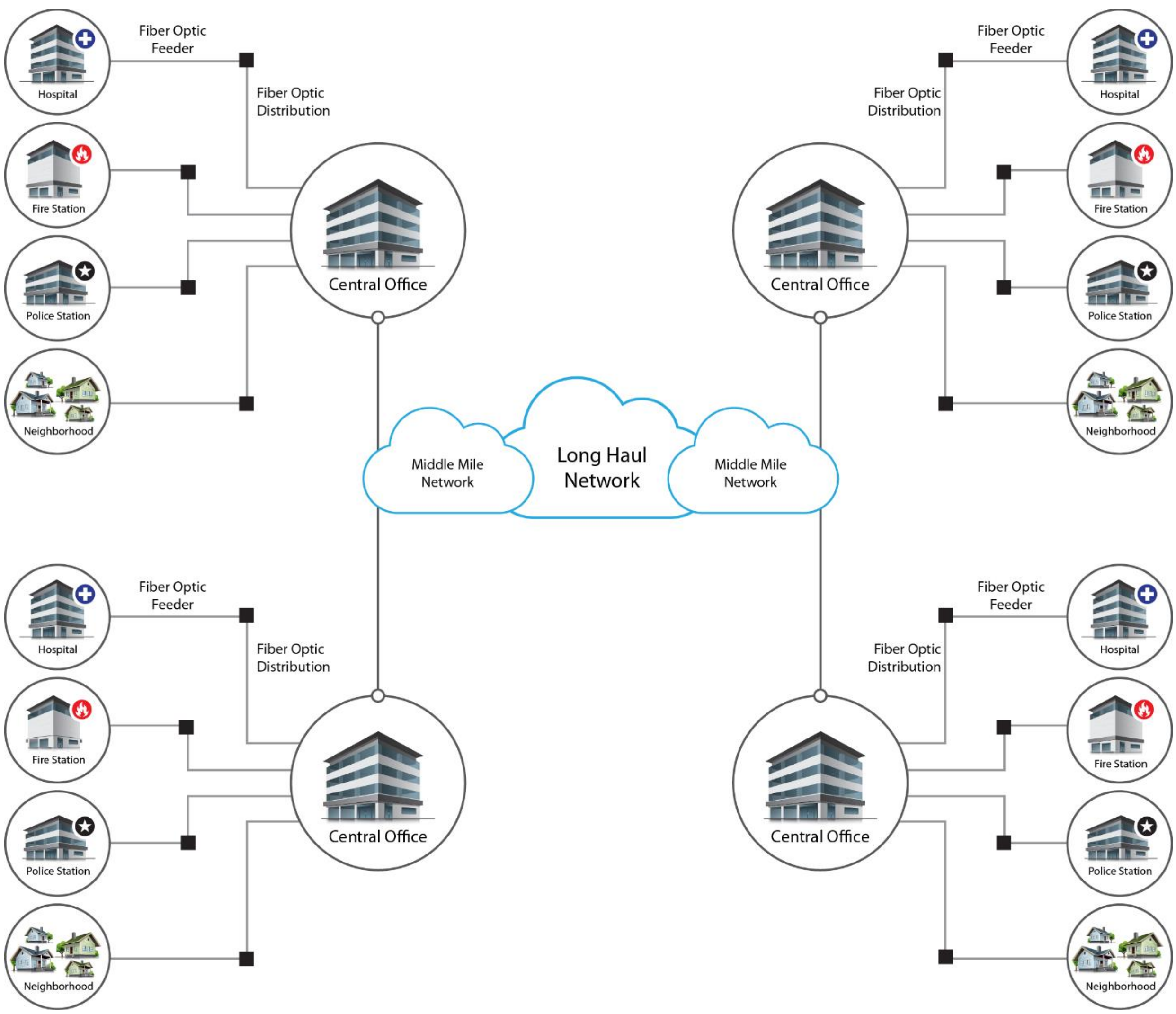


Figure 15.1.1-11: FCC Tower Structure Locations in Texas

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 15.1.1-12. 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 15.1.1-12: Typical Fiber Optic Network in Texas

Last Mile Fiber Assets

In Texas, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Texas there are 104 fiber providers that offer service in the state, as listed in Table 15.1.1-11. Figure 15.1.1-13 shows coverage for AT&T Southwest, Figure 15.1.1-14 shows coverage for Time Warner Cable and MegaPath Corporation, and Figure 15.1.1-15shows coverage for all other providers with less than 5 percent coverage area, respectively.[7]

Table 15.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
AT&T Southwest	4.48%
Time Warner Cable	2.83%
MegaPath Corporation	1.98%
Other[a]	20.94%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Valley Telephone Cooperative, Inc.; CenturyLink; Valor Telecommunications of Texas, L.P.; Santa Rosa Telephone Cooperative, Inc.; Verizon; South Plains Telephone Cooperative; Peoples Telephone Cooperative, Inc.; Eastex Telephone Cooperative, Inc.; Comcast; West Plains Telecommunications, Inc.; Suddenlink Communications, LLC; Central Texas Telephone Cooperative, Inc.; Big Bend Telephone Company; Poka Lambro Telecommunications; Cap Rock Telephone Cooperative; ACI; Mid-Plains Rural Telephone Cooperative, Inc.; Hill Country Telephone Cooperative, Inc.; Taylor Telephone Cooperative, Inc.; Charter Communications, Inc.; Southwest Texas Telephone Company; Consolidated Communications; West Texas Rural Telephone Coop, Inc.; XIT Rural Telephone Cooperative, Inc.; Guadalupe Valley Telephone Cooperative; Colorado Valley Communications, Inc.; Brazos Internet; Suddenlink Communications, LLC; Riviera Telephone Company, Inc.; Wes-Tex Telephone Cooperative, Inc.; Totelcom Communications, LLC; Etex dot net; Coleman County Telephone Cooperative; Level 3 Communications, LLC; Cable ONE; NTS Communications, Inc.; NewWave Communications; Grande Communications; Texas Windstream, Inc.; Border to Border Communications, Inc.; TW Telecom of Texas, LLC; Comcell; Nortex Communications; Northland Cable Television; Personal Touch Communications; Suddenlink Communications, LLC; Allegiance CATV; Suddenlink Communications, LLC; Ganado Telephone Company, Inc.; Industry Telephone Company; Alliance Communications Network; Etex Telecom; Dell Telephone Cooperative, Inc.; Zito Media; Lipan Telephone Company; Connextions Telecom; Westex Telecom; Reach Broadband; Electra Telephone Company; Panhandle Telephone Cooperative, Inc.; Longview Cable Television, Inc.; La Ward Telephone Exchange, Inc.; Fidelity Communications Inc.; Windstream Sugar Land, Inc.; TV Cable of Grayson County; North Texas Broadband; Plateau Telecommunications, Inc.; Windstream Communications Kerrville, LLC; Brazoria Telephone Company; Coastal-Link Communications; WT Services, Inc.; Livingston Telephone Company, Inc.; Mediastream; XIT Communications; Pathwayz Communications; Cameron Communications; VersaLink; Centrovision, Inc.; En-Touch Systems, Inc.; North Texas Telephone Company; Kilgore Cable Television, Inc.; OneSource Communications; GEUS; Web Fire Communications; TDS Telecom; Blossom Telephone; East Texas Cable; Harris Broadband LLP; Southwest Arkansas Telephone Cooperative; Tatum Telephone Company; Nortex Communications; Panhandle Telephone Cooperative, Inc.; Buffalo Cable Television; Telecom Cable, LLC; Reveille Broadband; Mountain Zone TV Systems; Cogent; Lake Livingston Telephone Company, Inc.; Pathway Com-Tel, Inc.; PTCI; and LiveAir Networks.

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

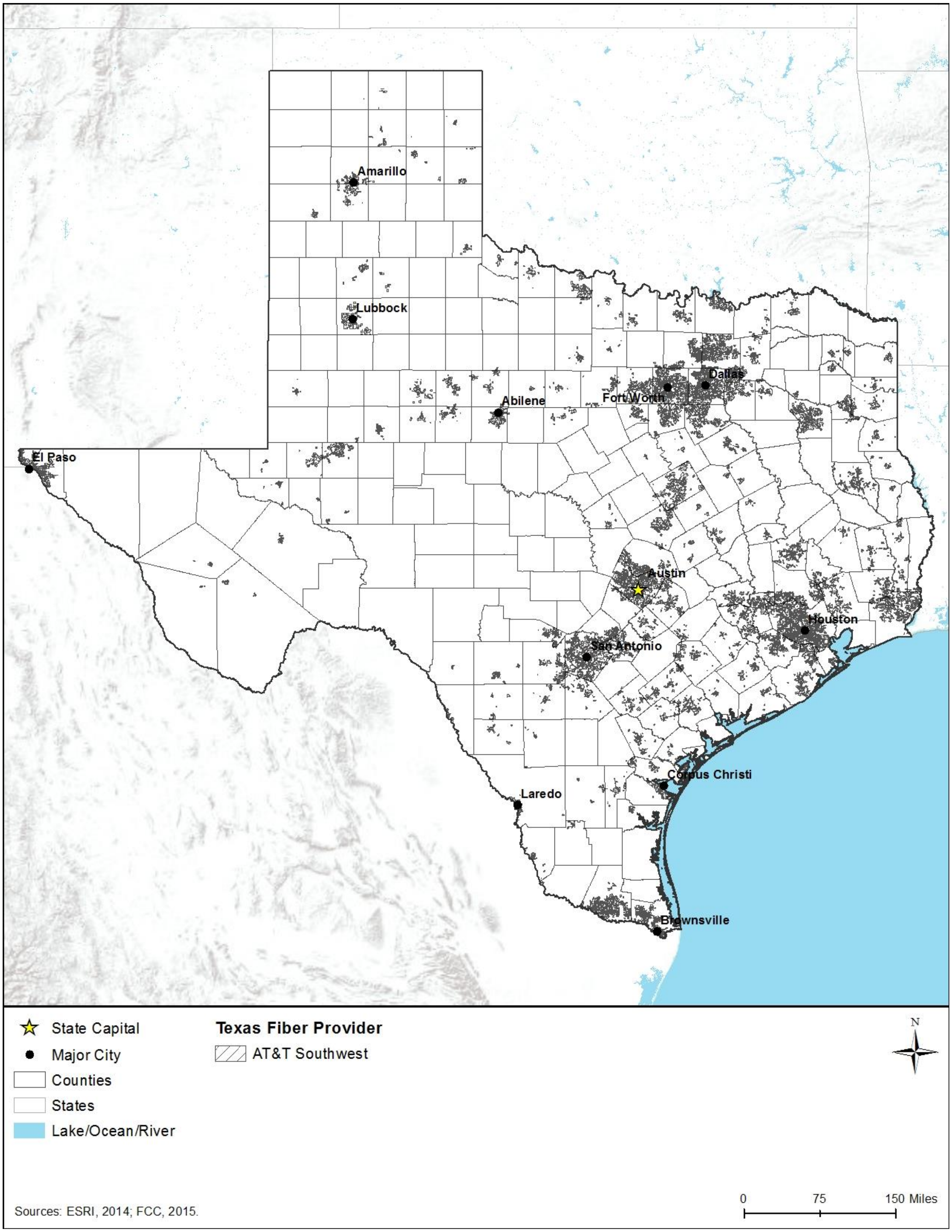


Figure 15.1.1-13: Fiber Availability in Texas for AT&T

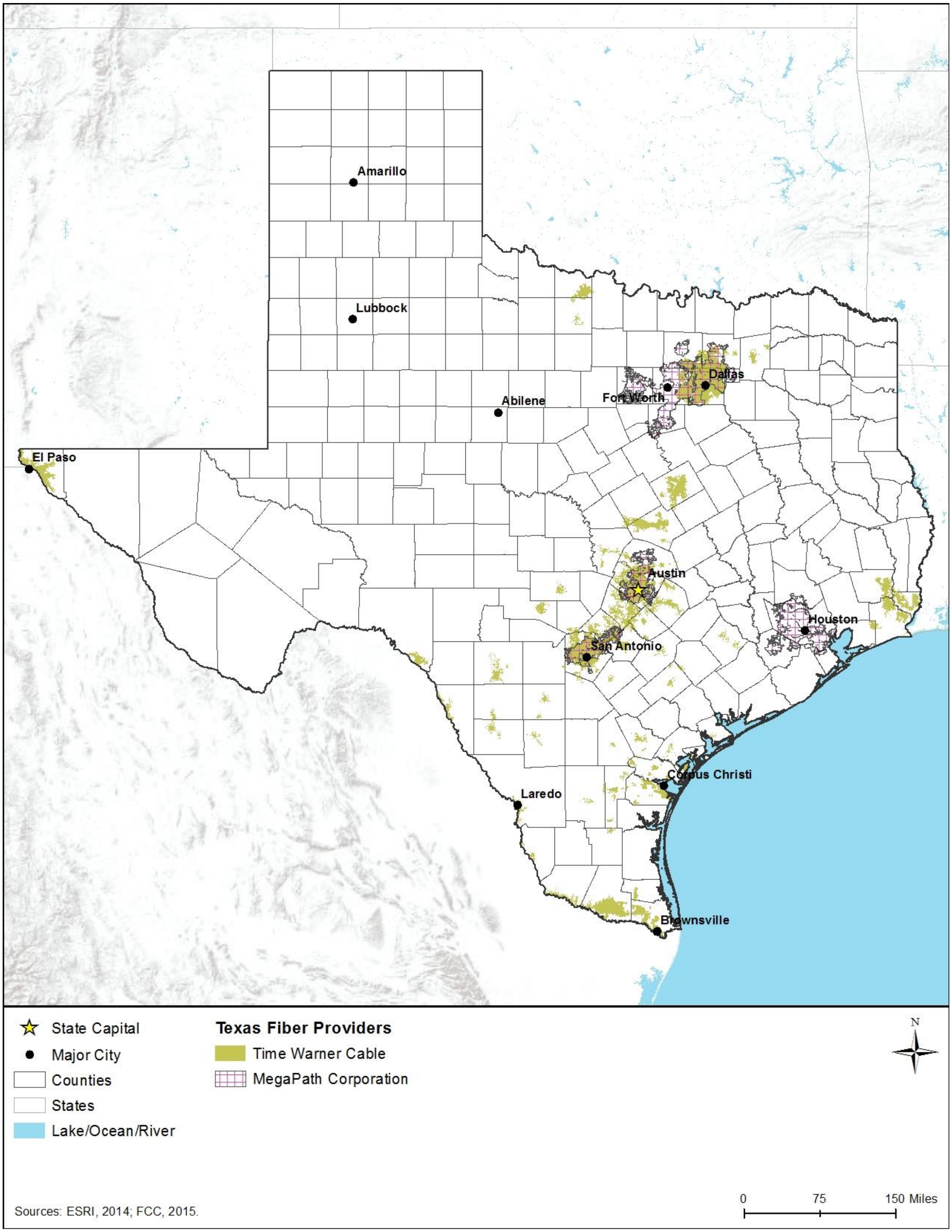


Figure 15.1.1-14: Time Warner Cable and MegaPath Fiber Availability in Texas

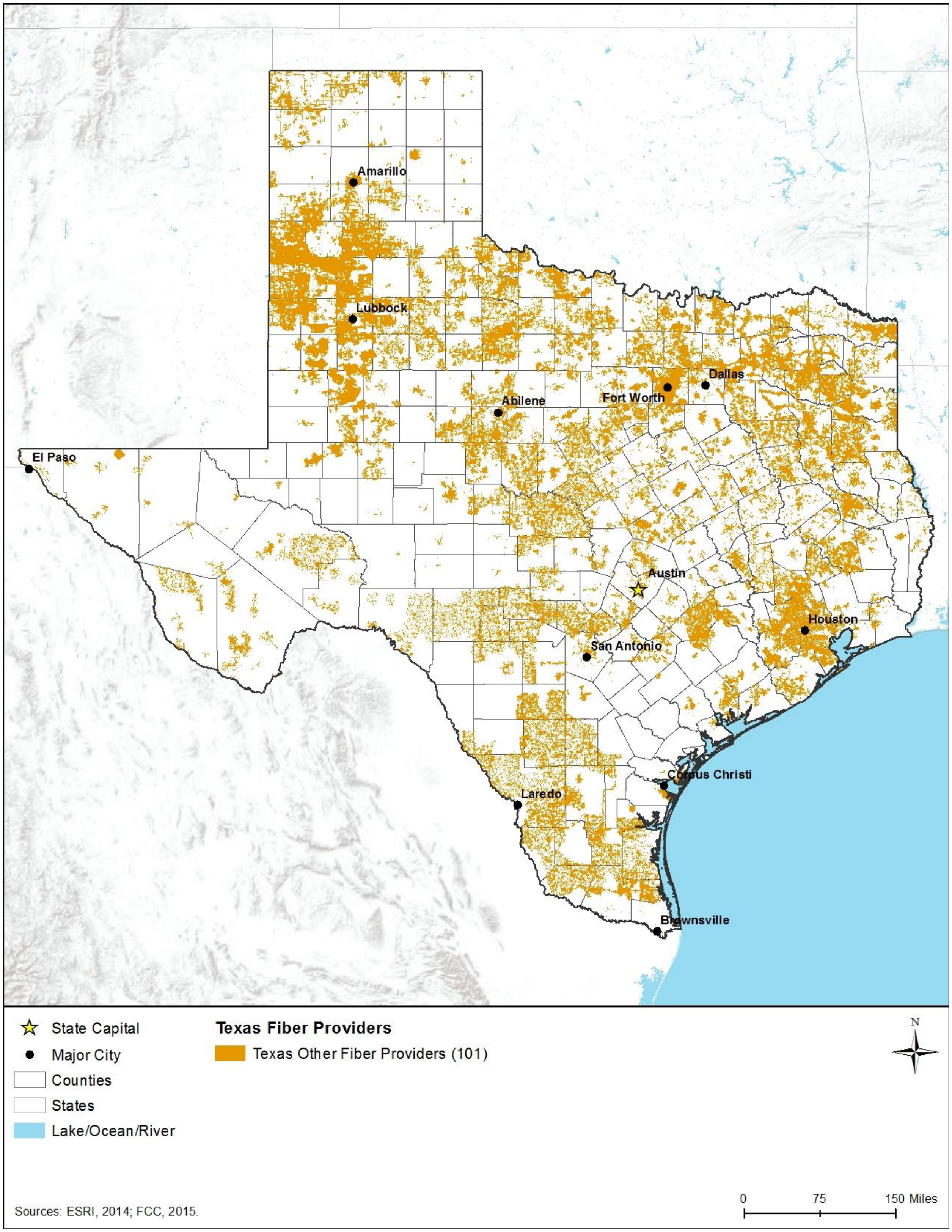


Figure 15.1.1-15: Other Providers Fiber Availability in Texas

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.

15.1.1.6. 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 15.1.4, Water Resources, describes the potable water sources in the state.

Electricity

The regulation of electric utilities in the state of Texas underwent a restructuring in 1999. Over the following several years, the Public Utility Commission of Texas (PUCT) changed its focus in the electricity industry "from regulation of rates and services to oversight of competitive markets and compliance enforcement of statutes and rules for the electric and telecommunication industries" (PUCT, 2015a). According to the PUCT, there are currently, 169 municipal electric utilities, 31 investor owned electric companies, 209 electric cooperatives, and 319 retail electric providers (PUCT, 2015b). Most of Texas' electricity comes from one of two sources: natural gas fueled generation plants and coal fueled electric generation plants (EIA, 2016a). In 2016, a total of 455,532 thousand megawatthours[8] of electricity was produced; of this, 227,554 thousand megawatthours (50.0 percent) came from natural gas, while coal fueled facilities produced 121,231 thousand megawatthours (26.6 percent) (EIA, 2016a). "Texas accounted for about 29% of U.S. marketed natural gas production in 2013, making it the leading natural gas producer among the states" (EIA, 2017a). Renewablesources generated 60,037 thousand megawatthours, while nuclear power plants generated 42,079 thousand megawatthours; both accounted for about 13.2 and 9.2 percent, respectively (EIA, 2017c). "Texas leads the nation in wind-powered generation capacity with more than 18,500 megawatts; in 2014 and 2015, Texas wind turbines produced moreelectricity than the state's two nuclear plants" (EIA, 2017a). Other sources of electricity such as biomass, solar power, and hydroelectric power generated negligible amounts of power (EIA, 2016a). Most of the energy consumed in the state is used by the industrial sector. In 2014, the industrial sector used 49.5 percent of the states' power, while the transportation sector used 24.2 percent, the residential sector 13.4 percent, and the commercial sector 12.9 percent (EIA, 2017a).

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[8] One megawatthour is defined as one thousand kilowatthours or 1 million watt-hours; where one watthour is "the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour." (EIA, 2016c)

Water

The quality of state drinking water and the regulations governing public water systems are all the purview of the Texas Commission on Environmental Quality (TCEQ) (TCEQ, 2015a). Their governance extends to Public Water Systems (PWSs), defined as a water system with "at least 15 service connections" or "serve at least 25 individuals for at least 60 days out of the year" (TCEQ, 2015b). These systems are broken into three categories: community, non-transient non-community, and transient non-community (TCEQ, 2015b). Community water systems can serve "at least 15 residential service connections on a year-round basis or serves at least 25 residents on a year-round basis" (TCEQ, 2015b); this category includes municipalities and schools. Non-transient non-community water systems regularly serve "at least 25 of the same persons at least six months out of the year" (TCEQ, 2015b); this includes schools and factories or other industries. Lastly, transient non-communities serve "at least 25 persons at least 60 days out of the year, yet by its characteristics, does not meet the definition of a non-transient non-community water system"; this would include parks or stores (TCEQ, 2015b). The state is home to a total of 4,631 active community PWSs, 1,390 transient non-community and 896 non-transient non-community (TCEQ, 2015c). The federal Safe Drinking Water Act (SDWA) mandates that public water systems complete a Source Water Assessment (SWA); a process that includes identifying both the sources of the water and any potential contaminants that could pose a risk. SWAs are used to influence source water protection programs in the state (TCEQ, 2015d). Information from the SWA is used in Consumer Confidence Reports (CCR), documents used to inform the public of water related information (CCR, 2015). These documents include "information about the source(s) of water used (i.e., rivers, lakes, reservoirs, or aquifers), chemical contaminants, bacteriological contaminants, compliance with drinking water rules, educational health information, water system contact information and public participation opportunities" (CCR, 2015). Much of this is information is collected for use in both SWAs and CCRs (CCR, 2015).

Wastewater

The treatment and discharge of wastewater in the state of Texas is managed through programs operated by the TCEQ. Their primary methods of management include the issuing of permits for the discharge of treated wastewater and the licensing of the operators of wastewater facilities (TCEQ, 2015e) (TCEQ, 2015f). The federal Clean Water Act mandates that anyone discharging pollutants through a point source into state waters must possess a National Pollutant Discharge Elimination System (NPDES) permit (USEPA, 2015a). In 1998, Texas was given authority to operate this plan on the state level (USEPA, 2015b). The Texas Pollutant Discharge Elimination System (TPDES) "has federal regulatory authority over discharges of pollutants to Texas surface water, with the exception of discharges associated with oil, gas, and geothermal exploration and development activities, which are regulated by the Railroad Commission of Texas" (TCEQ, 2015e). The TPDES program offers both individual and general permits. General permits are used to authorize a large number of dischargers in a given category or industry; such as the agriculture general permit or the municipal separate storm sewer system. Individual discharge permits are used to cover more specific discharger; however, this process is more intensive and time consuming (TCEQ, 2015g). As noted, the operators of wastewater facilities must be licensed by TCEQ. This is true of the operators of treatment facilities, both domestic and industrial, as well as the operators of wastewater collection systems. These licenses are categorized based on the type of treatment and discharge, as well as the number of millions of gallons per day that are produced (TCEQ, 2015f).

Solid Waste Management

The disposal of solid waste in Texas is managed and regulated by the TCEQ. Their annual report for the fiscal year 2014 lists 198 active landfills in the state (TCEQ, 2015h). One hundred of these landfills are considered Type I (standard landfill), 22 are Type IV (construction/demolition), 71 arid-exempt landfills (found in dry parts of Texas), and 5 monofills that serve municipalities with fewer than 12,000 people. There are also a total of 195 active processing facilities (TCEQ, 2015h). In 2014, a total of 32,371,574 tons of solid municipal waste was disposed of in the state of Texas; of this, 20,061,706 tons (61 percent) were landfilled in municipal facilities while 5,882,016 tons (18 percent) went to construction and demolition facilities. Brush, sludge, and contaminated soil also contributed the waste sent to landfills (TCEQ, 2015h). It is estimated that Texas landfills have a remaining capacity of 2.87 billion cubic yards, which should serve for another 60 years. "In 2015, the state legislature directed TCEQ to conduct a study on the current and potential economic impacts of recycling" with the results being publicized with the 2016 MSW Report (TCEQ, 2015h).

15.1.2. Soils

15.1.2.1. 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.

15.1.2.2. 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 15.1.2-1 below.

Table 15.1.2-1: Relevant Texas Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Texas Pollutant Discharge Elimination System (TPDES) Program	Texas Commission on Environmental Quality	Erosion and sediment controls are required under the TPDES program for permitted small and large construction activities that disturb one or more acre.

Source: (TCEQ, 2015i)

15.1.2.3. Environmental Setting

Texas is composed of seven Land Resource Region (LRR),[9] as defined by the Natural Resources Conservation Service (NRCS) (NRCS, 2006):

- Atlantic and Gulf Coast Lowland Forest and Crop Region;
- Central Great Plains Winter Wheat and Range Region;
- South Atlantic and Gulf Slope Cash Crops, Forest, and Livestock Region;
- Southwest Plateaus and Plains Range and Cotton Region;
- Southwestern Prairies Cotton and Forage Region;
- Western Great Plains Range and Irrigated Region; and
- Western Range and Irrigated Region.

Within and among Texas' seven LRRs are 36 Major Land Resource Areas (MLRA),[10] which are characterized by patterns of soils, climate, water resources, land uses, and type of farming (NRCS, 2006). The locations and characteristics of Texas' MLRAs are presented in Figure 15.1.2-1 and Table 15.1.2-2.

[9] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[10] 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).

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation and position on the landscape, biota[11] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[12] 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[13] (discussed further in the subsections below).

[11] The flora and fauna of a region.
[12] 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).
[13] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength (USFWS, 2009a).

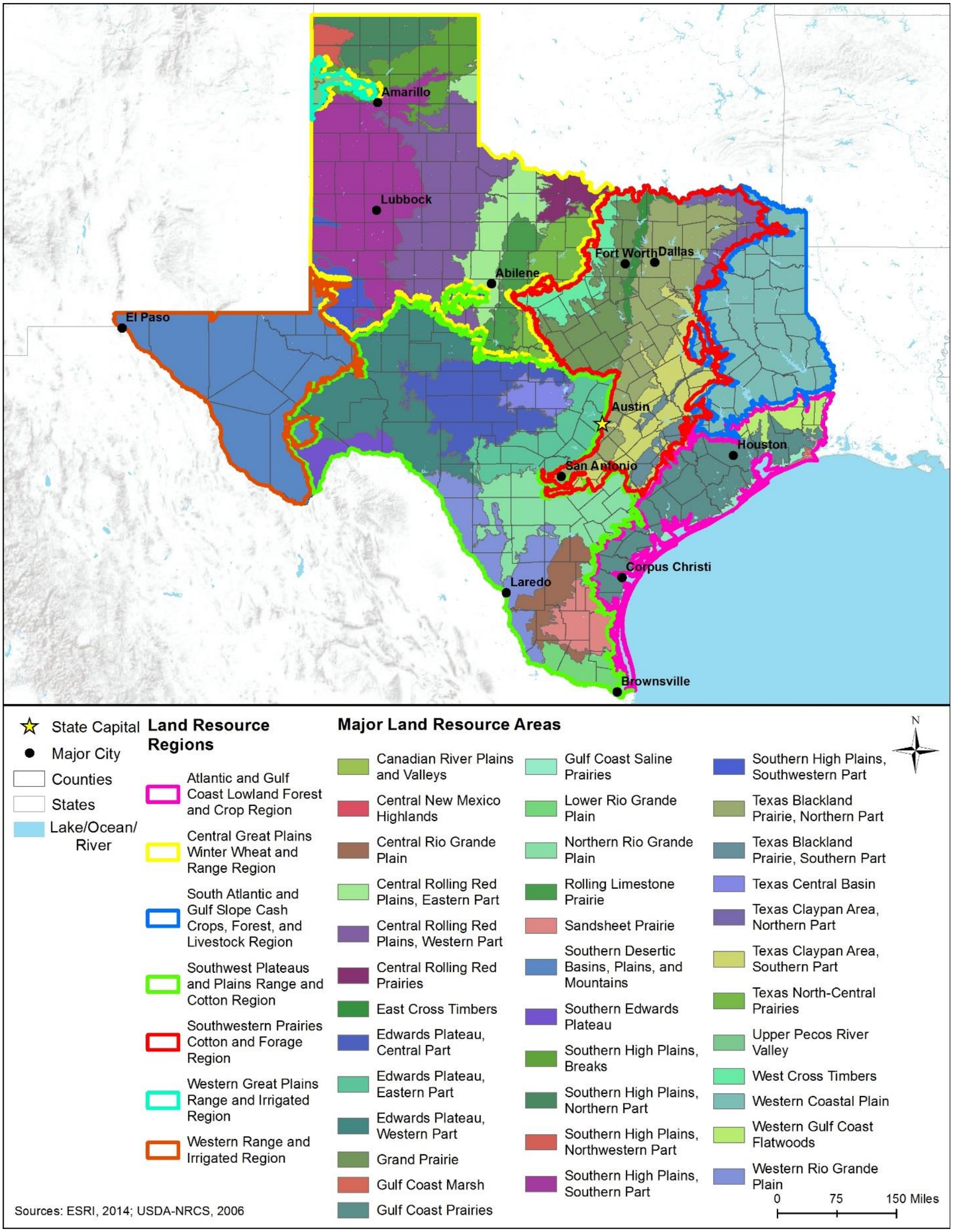

Figure 15.1.2-1: Locations of Major Land Resource Areas in Texas

Table 15.1.2-2: Characteristics of Major Land Resource Areas in Texas

MLRA Name	Region of State	Soil Characteristics
Canadian River Plains and Valleys	Northern Texas	Alfisols,[a] Entisols,[b] and Mollisols[c] are the dominant soil orders. These well drained soils are moderately textures or fine textured and range from shallow to deep.
Central New Mexico Highlands	Western Texas	Aridisols,[d] Entisols, and Mollisols are the dominant soil orders. These well drained soils range from very shallow to very deep, and are moderately fine textured to moderately coarse textured.
Central Rio Grande Plain	Southern Texas	Alfisols, Inceptisols,[e] Mollisols, and Vertisols[f] are the dominant soil orders. These soils range from somewhat poorly drained to well drained, and range from very shallow to very deep.
Central Rolling Red Plains, Eastern Part	North-central Texas	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These moderately deep to very deep soils are clayey or loamy,[g] and are moderately well drained to well drained.
Central Rolling Red Plains, Western Part	West-central Texas	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These well drained soils are loamy, clayey, or sandy, and range from very shallow to very deep.
Central Rolling Red Prairies	North-central Texas	Mollisols is the dominant soil order. These well drained soils range from shallow to very deep, and are clayey or loamy.
East Cross Timbers	North-central Texas	Alfisols, Entisols, and Mollisols are the dominant soil orders. These clayey or sandy soils are well drained to somewhat excessively drained, and are moderately deep to very deep.
Edwards Plateau, Central Part	Central Texas	These soils are primarily Mollisols. They are well drained and range from shallow to very deep.
Edwards Plateau, Eastern Part	Central Texas	Inceptisols and Mollisols are the dominant soil orders. These soils are well drained and range from shallow to very deep.
Edwards Plateau, Western Part	West-central Texas	Mollisols is the dominant soil orders. These soils are well drained, and range from shallow to very deep.
Grand Prairie	North-central Texas	Mollisols and Vertisols are the dominant soil orders. These well drained soils range from very shallow to very deep.
Gulf Coast Marsh	Eastern Texas	Entisols and Histosols[h] are the dominant soil orders. These clayey and very poorly drained soils are typically very deep.
Gulf Coast Prairies	Southeastern Texas	Alfisols, Mollisols, and Vertisols are the dominant soil orders. These loamy or clayey soils are very deep and range from very poorly drained to well drained.
Gulf Coast Saline Prairies	Southeastern Texas	Alfisols, Entisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These loamy or sandy soils are very deep and range from very poorly drained to excessively drained.

MLRA Name	Region of State	Soil Characteristics
Lower Rio Grande Plain	Southern Texas	Alfisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These clayey or loamy soils are very deep, and are moderately well drained to well drained.
Northern Rio Grande Plain	Southern Texas	Alfisols, Mollisols, and Vertisols are the dominant soil orders. These clayey or loamy soils are very deep, and are moderately well drained to well drained.
Rolling Limestone Prairie	North-central Texas	Entisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These well drained soils are clayey or loamy, and range from very shallow to very deep.
Sandsheet Prairie	Southern Texas	Alfisols, Entisols, and Inceptisols are the dominant soil orders. These sandy or loamy soils range from poorly drained to excessively drained and are deep to very deep.
Southern Desertic Basins, Plains, and Mountains	Western Texas	Aridisols, Entisols, Mollisols, and Vertisols are the dominant soil orders. These loamy or clayey soils are typically moderately deep to very deep, and are well drained.
Southern Edwards Plateau	Western Texas	Aridisols and Entisols are the dominant soil orders. These well drained soils range from shallow to very deep.
Southern High Plains, Breaks	Northern Texas	Alfisols, Inceptisols, and Mollisols are the dominant soil orders. These well drained soils range from shallow to very deep, and are sandy or loamy.
Southern High Plains, Northern Part	Northern Texas	Alfisols and Mollisols are the dominant soil orders. These loamy soils are typically well drained and very deep.
Southern High Plains, Northwestern Part	Northern Texas	Alfisols are the dominant soil orders. These well drained soils are typically very deep, and are sandy or loamy.
Southern High Plains, Southern Part	Northwestern Texas	Alfisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These well drained soils are typically moderately deep to very deep, and are loamy, clayey, or sandy.
Southern High Plains, Southwestern Part	Western Texas	Aridisols and Entisols are the dominant soil orders. These well drained soils range from very shallow to very deep, and are typically sandy or loamy.
Texas Blackland, Northern Part	Eastern Texas	Entisols, Mollisols, and Vertisols are the dominant soil orders. These moderately well drained to well drained soils range from shallow to very deep.
Texas Blackland Prairie, Southern Part	East-central Texas	Entisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These silty or loamy soils are moderately well drained to well drained, and range from shallow to very deep.
Texas Central Basin	Central Texas	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These soils are shallow to very deep, and are well drained.
Texas Claypan Area, Northern Part	Northeastern Texas	Alfisols, Ultisols,[i] and Vertisols are the dominant soil orders. These deep soils are clayey or loamy, and range from poorly drained to well drained.

MLRA Name	Region of State	Soil Characteristics
Texas Claypan Area, Southen Part	South-Central Texas	Alfisols, Entisols, Mollisols, and Vertisols are the dominant soil orders. These soil range from poorly drained to excessively drained, and are moderately deep to very deep.
Texas North-Central Prairies	North-Central Texas	Alfisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These clayey or loamy soils range from very shallow to very deep, and are moderately well drained to well drained.
Upper Pecos River Valley	Northern Texas	Aridisols and Entisols are the dominant soil orders. These well drained soils range from shallow to very deep, and are coarse textured to fine textured.
West Cross Timbers	East-central Texas	Alfisols and Entisols are the dominant soil orders. These loamy or clayey soils are typically moderately well drained to well drained, and are deep or very deep.
Western Coastal Plain	Eastern Texas	Alfisols and Ultisols are the dominant soil orders. These clayey or loamy soils typically range from poorly drained to well drained, and are very deep.
Western Gulf Coast Flatwoods	Eastern Texas	Alfisols and Ultisols are the dominant soil orders. These typically very deep and loamy or clayey soils range from very poorly drained to moderately well drained.
Western Rio Grande Plain	Southern Texas	Alfisols, Aridisols, Inceptisols, Mollisols, and Vertisols are the dominant soil orders. These clayey or loamy soils are moderately well drained to well drained, and are moderately deep to very deep.

Source: (NRCS, 2006)

[a] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world's ice-free land surface." (NRCS, 2015b)
[b] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface." (NRCS, 2015b)
[c] Mollisols: "Soils that have a dark colored surface horizon relatively high in content of organic matter. They are base rich throughout and quite fertile. Mollisols form under grass in climates that have a moderate to pronounced seasonal moisture deficit." (NRCS, 2015b)
[d] Aridisols: "Soils that are too dry for the growth of mesophytic plants. Lack of moisture greatly restricts the intensity of the weathering process and limits most soil development processes to the upper part of the soils. They make up about 12% of the world's ice-free land surface." (NRCS, 2015b)
[e] 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% of the world's ice-free land surface." (NRCS, 2015b)
[f] Vertisols: "Vertisols have a high content of expanding clay minerals. They undergo pronounced changes in volume with changes in moisture, and have cracks that open and close periodically, and that show evidence of soil movement. Vertisols transmit water very slowly, have undergone little leaching, and tend to be high in natural fertility. They make up about 2% of the world's ice-free land surface." (NRCS, 2015b)
[g] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)
[h] Histosols: "Histosols have a high content of organic matter and no permafrost. Most are saturated year round, but a few are freely drained. They form in decomposed plan remains that accumulate in water, forest litter, or moss faster than they decay. Histosols make up about 1% of the world's ice-free land surface." (NRCS, 2015b)
[i] 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% of the world's ice-free land surface." (NRCS, 2015b)

15.1.2.4. 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[14]; there are 12 soil orders in the world and they are characterized by both observed and inferred[15] 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[16] soil database identifies 25 different soil suborders in Texas (NRCS, 2015d). Figure 15.1.2-2 depicts the distribution of the soil suborders, and Table 15.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[14] A formal representation of relationships between items in a hierarchical structure" (USEPA, 2013c).
[15] "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).
[16] STATSGO2 is the Digital General Soil Map of the United States that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset.

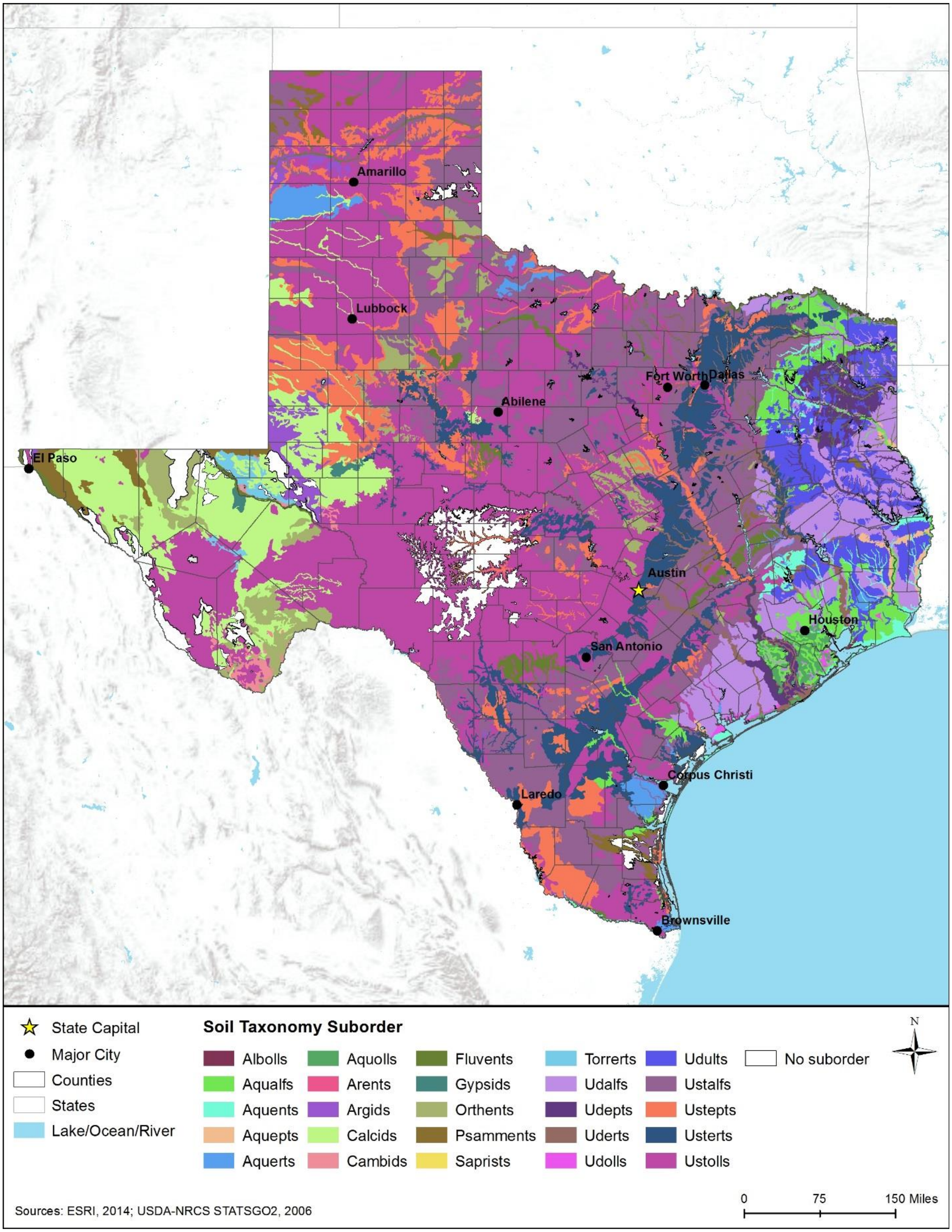

Figure 15.1.2-2: Texas Soil Taxonomy Suborders

Table 15.1.2-3: Major Characteristics of Soil Suborders[a] Found in Texas, as depicted in Figure 15.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Mollisols	Albolls	Albolls have a fluctuating ground water table, with gentle slopes. They supported grasses and shrubs, and are typically used as cropland.	Fine sandy loam	0-2	Somewhat poorly drained	No	D	High	Very Low	High	Low
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, Clay loam, Loamy fine sand, Sandy clay loam, Silt loam	0-3	Poorly drained to moderately well drained	No, Yes	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Clay, Fine sand, Fine sandy loam, Loam, Loamy fine sand, Muck, Silty clay, Silty clay loam, Stratified loam to silty clay loam, Stratified loamy sand to loam, Variable	0-4	Very poorly drained to poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, ground water is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Clay, Clay loam	0-1	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Aquerts	Aquerts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay, Clay loam, Sandy clay loam, Stratified loamy fine sand to clay loam, Stratified silt loam to silty clay loam	0-1	Poorly drained to somewhat poorly drained	No, Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Clay, Clay loam, Loam	0-1	Very poorly drained to somewhat poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Arents	Arents are predominantly used for pasture, crops, wildlife habitat, and urban land. Since they have been subject to various means of mixing, they lack diagnostic horizons.	Variable	1-5	-	No	B	Medium	Moderate	Medium	Low
Aridisols	Argids	Argids are found in the western United States. They are primarily used as wildlife habitat or rangeland, although some can also be used as cropland, if irrigated.	Cemented, Fine sand, Fine sandy loam, Sandy clay loam, Weathered bedrock	0-8	Well drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low
Aridisols	Calcids	Calcids are found in the western United States, and used primarily as wildlife habitat or rangeland, although some have been utilized as irrigated cropland. They have high levels calcium carbonates that persist due to insufficient precipitation.	Cemented, Clay loam, Extremely gravelly loam, Fine sandy loam, Gravelly loam, Indurated, Loam, Silty clay loam, Variable, Very cobbly loam, Very fine sandy loam, Very gravelly fine sandy loam, Very gravelly loam, Very gravelly sandy loam, Very gravelly silt loam	0-45	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Aridisols	Cambids	Cambids are found in the western United States, with little soil development. They are primarily used as wildlife habitat or rangeland, although some can also be used as cropland, if irrigated.	Fine sandy loam, Silt loam, Silty clay loam, Very gravelly clay loam	0-45	Well drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
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.	Clay loam, Fine sandy loam, Loam, Loamy sand, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stratified fine sand to clay loam, Stratified fine sand to loam, Stratified very fine sandy loam to silty clay loam, Very fine sandy loam	0-3	Moderately well drained to somewhat excessively drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low
Aridisols	Gypsids	Gypsids are soils with a petrogypsic or gypsic horizon. These soils have limited uses, and are predominantly utilized for wildlife habitat or rangeland.	Gypsiferous material, Loam	0-3	Well drained	No	B	Medium	Moderate	Medium	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Channery clay, Clay, Clay loam, Fine sandy loam, Loam, Silt loam, Unweathered bedrock, Very channery loam, Very gravelly clay loam, Very gravelly loam, Weathered bedrock	0-50	Well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	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, Loamy fine sand, Loamy sand, Sand, Stratified loamy fine sand to very fine sandy loam	0-45	Somewhat excessively drained to excessively drained	No	A	Low	High	Low	Low
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	0-1	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Vertisols	Torrerts	Torrerts are soils that consist of primarily grasses and forbs and are used as rangeland. Their slow permeability means that irrigation can cause waterlogging and accumulation of salinity without other means of drainage.	Clay, Clay loam	0-3	Moderately well drained to well drained	No	D	High	Very Low	High	Low
Alfisols	Udalfs	Udalfs have an udic (humid or subhumid climate) moisture regime, and are believed to have supported forest vegetation at some time during development.	Channery clay, Clay, Clay loam, Fine sandy loam, Loam, Loamy fine sand, Loamy sand, Sandy clay loam, Silt loam, Silty clay loam, Stratified sandy clay loam to clay, Unweathered bedrock, Very fine sandy loam	0-25	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
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the Northwest and mixed or hardwood forest in the East. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Loam, Sandy clay, Silt loam	0-1	Moderately well drained to well drained	No, Yes	B, C	Medium	Moderate, Low	Medium	High, due to hydric soil and poor drainage conditions

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Clay, Silty clay loam	0-15	Poorly drained to moderately well drained	No, Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay loam, Silty clay loam	0-3	Somewhat poorly drained to moderately well drained	No	D	High	Very Low	High	Low
Ultisols	Udults	Udults are more or less freely drained, relatively humus poor, and have an udic moisture regime. Most of these soils currently support or formerly supported mixed forest vegetation, and many have been cleared and used as cropland (mostly with the use of soil amendments).	Clay, Clay loam, Fine sand, Fine sandy loam, Gravelly fine sandy loam, Loam, Loamy fine sand, Sandy clay, Sandy clay loam, Stratified fine sandy loam to clay, Stratified sandy clay loam to clay, Very gravelly silty clay	0-25	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
Alfisols	Ustalfs	Ustalfs are primarily used for grazing or cropland, and they also support savanna and grassland vegetation. They are found in areas with a marked dry season.	Clay, Clay loam, Extremely gravelly clay loam, Fine sand, Fine sandy loam, Gravelly fine sandy loam, Gravelly loamy fine sand, Gravelly loamy sand, Loam, Loamy fine sand, Loamy sand, Sandy clay, Sandy clay loam, Sandy loam, Silty clay loam, Stratified channery clay, Very cobbly fine sandy loam, Very fine sandy loam, Very gravelly sandy clay loam, Weathered bedrock	0-25	Somewhat poorly drained to somewhat excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High	Low
Inceptisols	Ustepts	Ustepts are freely drained soils, typically used as pasture or cropland, although some support forest, rangeland, and wildlife habitat.	Cemented, Clay, Clay loam, Fine sandy loam, Gravelly clay loam, Gravelly loam, Gravelly sandy loam, Loam, Loamy fine sand, Sandy clay loam, Silt loam, Silty clay, Silty clay loam, Very fine sandy loam, Weathered bedrock	0-50	Moderately well drained to well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Vertisols	Usterts	Usterts are soils with low permeability, and receive low rainfall amounts. They support grasses and forbs, and are mostly used for rangeland or cropland. However, but due to their low permeability, they typically need to be artificially drained if irrigated, to prevent standing water and a buildup of salinity.	Channery clay, Clay, Silty clay, Silty clay loam	0-8	Somewhat poorly drained to well drained	No, Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Mollisols	Ustolls	Ustolls typically supported grass and forest vegetation, and are now primarily used as cropland or rangeland. They are generally freely drained, and found in subhumid to semiarid climates. Areas with drought are common, and blowing soil can be an issue.	Cemented, Clay, Clay loam, Cobbly clay, Extremely stony loam, Fine sandy loam, Gravelly clay loam, Gravelly loam, Indurated, Loam, Sandy clay, Sandy clay loam, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stony clay loam, Stratified clay to channery clay, Stratified loam to clay, Unweathered bedrock, Variable, Very cobbly clay, Very cobbly loam, Very fine sandy loam, Very gravelly clay loam, Very gravelly loam, Very gravelly sandy loam, Weathered bedrock	0-50	Somewhat poorly drained to well drained	No, Yes	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions

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

[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: "A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (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.
[c] Based on Runoff Potential, described in Section 15.1.2.5

15.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[17] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 15.1.2-3 provides a summary of the runoff potential for each soil suborder in Texas.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[18] 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). Argids, Fluvents, Psamments, Udalfs, Udults, Ustalfs, and Ustolls fall into this category in Texas.

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. Aqualfs, Arents, Argids, Calcids, Cambids, Fluvents, Gypsids, Orthents, Udalfs, Udepts, Udults, Ustalfs, Ustepts, and Ustolls fall into this category in Texas.

Group C. **Sandy clay loam soils.** This group of soils has "low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure" (Purdue University, 2015). This group has medium runoff potential. Aqualfs, Aquents, Aquepts, Argids, Calcids, Fluvents, Orthents, Udalfs, Udepts, Udults, Ustalfs, Ustepts, and Ustolls fall into this category in Texas.

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). Albolls, Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Calcids, Cambids, Orthents, Saprists, Torrerts, Udalfs, Uderts, Udolls, Udults, Ustalfs, Ustepts, Usterts, and Ustolls fall into this category in Texas.

15.1.2.6. 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

[17] 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.
[18] 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).

public safety hazard (NRCS, 1996a). Table 15.1.2-3 provides a summary of the erosion potential for each soil suborder in Texas. Soils with medium to high erosion potential in Texas include those in the Albolls, Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Arents, Argids, Calcids, Cambids, Fluvents, Gypsids, Orthents, Saprists, Torrerts, Udalfs, Udepts, Uderts, Udolls, Udults, Ustalfs, Ustepts, Usterts, and Ustolls suborders, which are found throughout most of the state (Figure 15.1.2-2).

15.1.2.7. 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 10 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 15.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Texas. Soils with the highest potential for compaction and rutting in Texas include those in the Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Saprists, Udepts, Uderts, Usterts, and Ustolls suborders, which are found throughout the state (Figure 15.1.2-2).

15.1.3. Geology

15.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 15.1.4), Climate Change (Section 15.1.14), and Human Health and Safety (Section 15.1.15).

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

- Section 15.1.3.3, Environmental Setting: Physiographic Regions and Provinces;[19,20]
- Section 15.1.3.4, Surface Geology;
- Section 15.1.3.5, Bedrock Geology;[21]
- Section 15.1.3.6, Paleontological Resources;[22]
- Section 15.1.3.7, Fossil Fuel and Mineral Resources; and
- Section 15.1.3.8, Geologic Hazards.[23]

15.1.3.2. 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 15.1.2-1.

Table 15.1.3-1: Relevant Texas Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Texas Structural Codes	Texas Department of Licensing and Regulation	Guidelines on seismic building design.

Source: (Texas State Law Library, 2015)

15.1.3.3. Environmental Setting: Physiographic Regions and Provinces

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

Texas is within three major physiographic regions: Atlantic Plain (Coastal Plain Province), Interior Plains (Central Lowland and Great Plains Provinces), and Intermontane Plateau (Basin and Range Province) (NPS, 2017). The locations of these regions are shown in Figure 15.1.3-1 and their general characteristics summarized in the following subsections.

[19] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, N., 1916).
[20] Physiographic provinces: Subsets within physiographic regions (Fenneman, N., 1916).
[21] Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015e).
[22] Paleontology: "Study of life in past geologic time based on fossil plants and animals" (USGS, 2015f).
[23] 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).

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 strata become thinner moving westward through the region, and thicken to several thousand feet thick along the coastline. Erosion from the Appalachian Mountains dislodged sediments, which were subsequently deposited by rivers to form the Atlantic Plain.[24] (NPS, 2015f)

Coastal Plain Province – As reported above, the Atlantic Plain Region within Texas is composed of one physiographic province the Coastal Plain Province (USGS, 2003b). Within Texas, the Coastal Plain extends from the coastline along the Gulf of Mexico to a line just west of San Antonio and Dallas. "From sea level at the Gulf of Mexico, the elevation of the [Coastal Plain Province] increases northward and westward. In the Austin [/] San Antonio area, the average elevation is about 800 feet. South of Del Rio, the western end of the [Coastal Plain] has an elevation of about 1,000 feet." Areas closest to the coast are composed of "deltaic sands, silts, and clays erode to nearly flat grasslands that form almost imperceptible slopes to the southeast." Further inland, the Coastal Plain's geology consists of alternating layers of sands and shales.[25] (BEG, 2014)

[24] 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)
[25] 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).

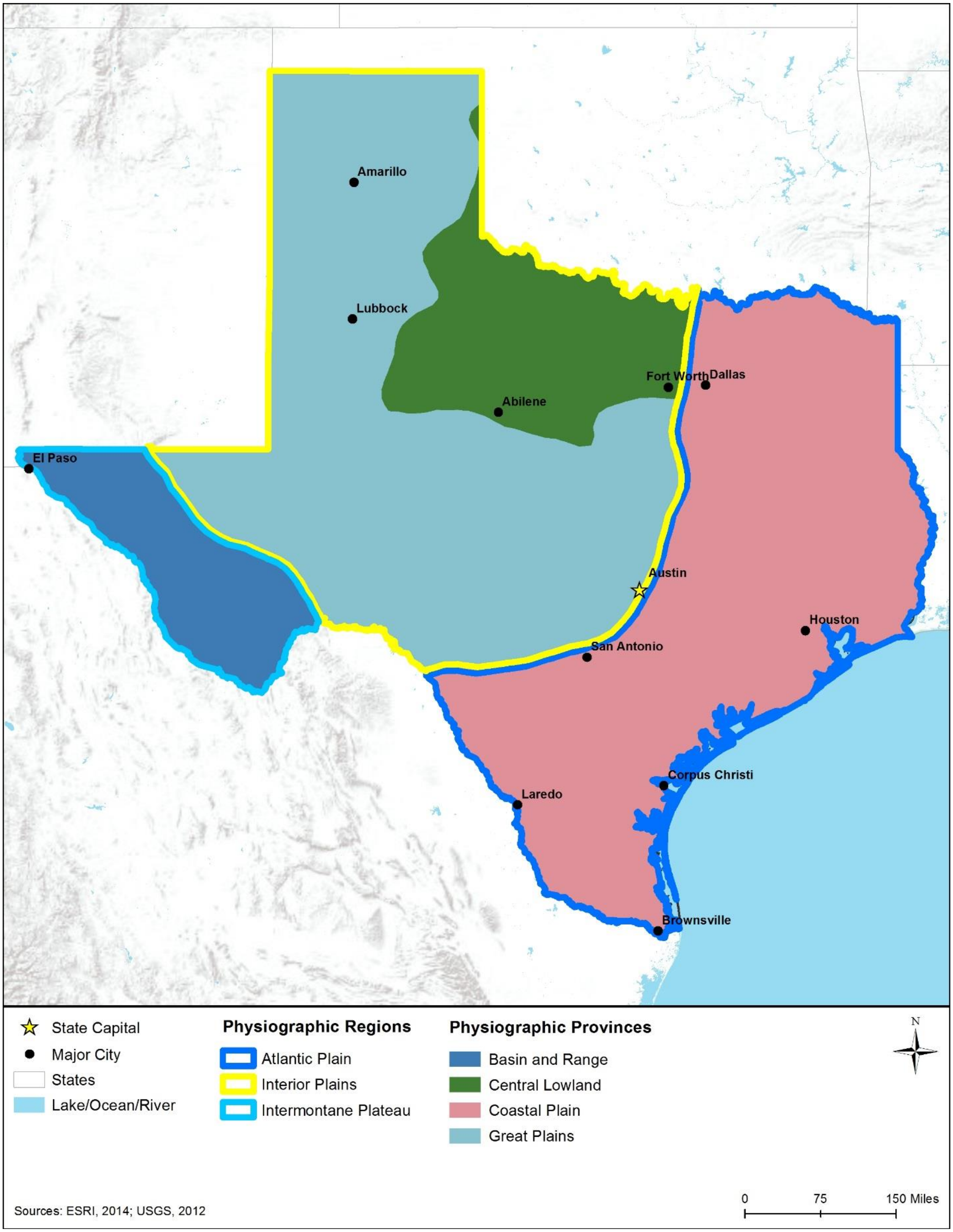

Figure 15.1.3-1: Physiographic Regions and Provinces of Texas

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama), and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, N., 1916). Metamorphic[26] and igneous[27] rocks dating to the Precambrian Era (older than 542 MYA) underlie the entire region. There is minimal topographic relief throughout the region, except for the Black Hills of South Dakota. During the Mesozoic Era, much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary[28] rocks, which lie on top of the Precambrian basement rocks. Erosion from the Rocky Mountains to the west and the Ozark/Ouachita Mountains to the east, also contributed to the formation of sandstone,[29] mudstone,[30] and clay (USGS, 2014b).

Central Lowland Province – The Central Lowland Province[31] includes portions of north-central Texas, including the Cities of Fort Worth and Dallas, as well as the easternmost sections of the Texas Panhandle. This area of Texas is generally underlain by limestone,[32] sandstone,[33] and shale. Elevations throughout the province range between 900 and 3,000 feet ASL (BEG, 1996). "An erosional surface that developed on upper Paleozoic formations forms the [Central Lowland Province]. Where shale bedrock prevails, meandering rivers traverse stretches of local prairie. In areas of harder bedrock, hills and rolling plains dominate. Local areas of hard sandstones and limestones cap steep slopes severely dissected near rivers" (BEG, 2014).

Great Plains Province – The Great Plains Province includes much of northern and central Texas including much of the Texas Panhandle. "The Great Plains Physiographic Province is an east-tilted surface formed by deposition of sediment eroded from the ancestral Rocky Mountains, beginning about 65 [MYA]" (USGS, 2014d). The Great Plains are generally above 2,000 feet ASL. In northernmost Texas, the Great Plains reach elevations in excess of 4,700 feet ASL (BEG, 1996). "Generally along the eastern edge of the [Great Plains] there is a steep slope down to the Central Lowland. Throughout much of its extent this steep slope is [300 to 600 feet high], at some places straight, at others made irregular by the erosion of streams that head in the plateau and flow eastward" (Fenneman, 1922).

[26] Metamorphic Rocks: "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).
[27] Igneous Rocks: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)" (USGS, 2015g).
[28] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding" (USGS, 2014c).
[29] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015g).
[30] Mudstone: "A very fine-grained sedimentary rock formed from mud" (USGS, 2015g).
[31] Note that the Central Lowland Province corresponds to the area described as the North-Central Plains on the Physiographic Map of Texas (BEG, 1996).
[32] 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).
[33] Sandstone: "Sedimentary rock made mostly of sand-sized grains" (USGS, 2015g).

Intermontane Plateau Region

The Intermontane Plateau Region describes the area between the Rocky Mountains and the Sierra Nevada and Cascade Ranges, and includes areas as far east as western Texas. The Intermontane Plateau Region dates to 80 million years ago (MYA) and predates the younger Rocky Mountain System to the east (which was created roughly 60 MYA). The region is characterized by interspersed higher-elevation plateaus and mountains and lower-lying basins. The Colorado Plateau and Columbia Plateau are the major elevated areas, while the Basin and Range geologic province includes the region's lowest elevations. (Lew, 2004)

<u>Basin and Range Province</u> – The Basin and Range Province includes westernmost Texas, including the city of El Paso. This province is characterized by north-south trending mountain ranges and intervening valleys, and includes both igneous and metamorphic underlying rocks (BEG, 1996). "Cores of strongly folded and faulted sedimentary and volcanic rocks or of granite[34] rocks compose the interiors of mountain ranges. Volcanic rocks form many peaks." Elevations throughout the province range between 1,700 and more than 8,700 feet ASL. "At [8,749] [ASL], Guadalupe Peak is the highest point in Texas" (BEG, 2014).

15.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[35] 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,[36] subsidence,[37] and erosion (Thompson, 2015).

While the Pleistocene (2.6 MYA to 11,700 years ago) glaciation did not reach Texas, glaciers to the north formed meandering streams that delivered sediment deposits to eastern Texas. The surface geology in north and western Texas also includes Pleistocene alluvial[38] and eolian[39] deposits that emanated from the Pecos River. Fluctuating sea levels, along with gradual uplift that occurred throughout the state, brought delta and coastal sedimentary deposits along the Gulf Coast of Texas (Bureau of Economic Geology, 1992). Figure 15.1.3-2 depicts a generalized illustration of the surficial composition for Texas.

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[34] Granite: "A coarse-grained intrusive igneous rock with at least 65% silica. Quartz, plagioclase feldspar and potassium feldspar make up most of the rock and give it a fairly light color" (USGS, 2015g).
[35] 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).
[36] 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).
[37] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000).
[38] Alluvium: "Sand, gravel, and silt deposited by rivers and streams in a valley bottom" (USGS, 2015g).
[39] Eolian: "Term describing the process of wind erosion, transport, and deposition, and wind-created deposits and structures such as sand dunes" (USGS, 2015g).

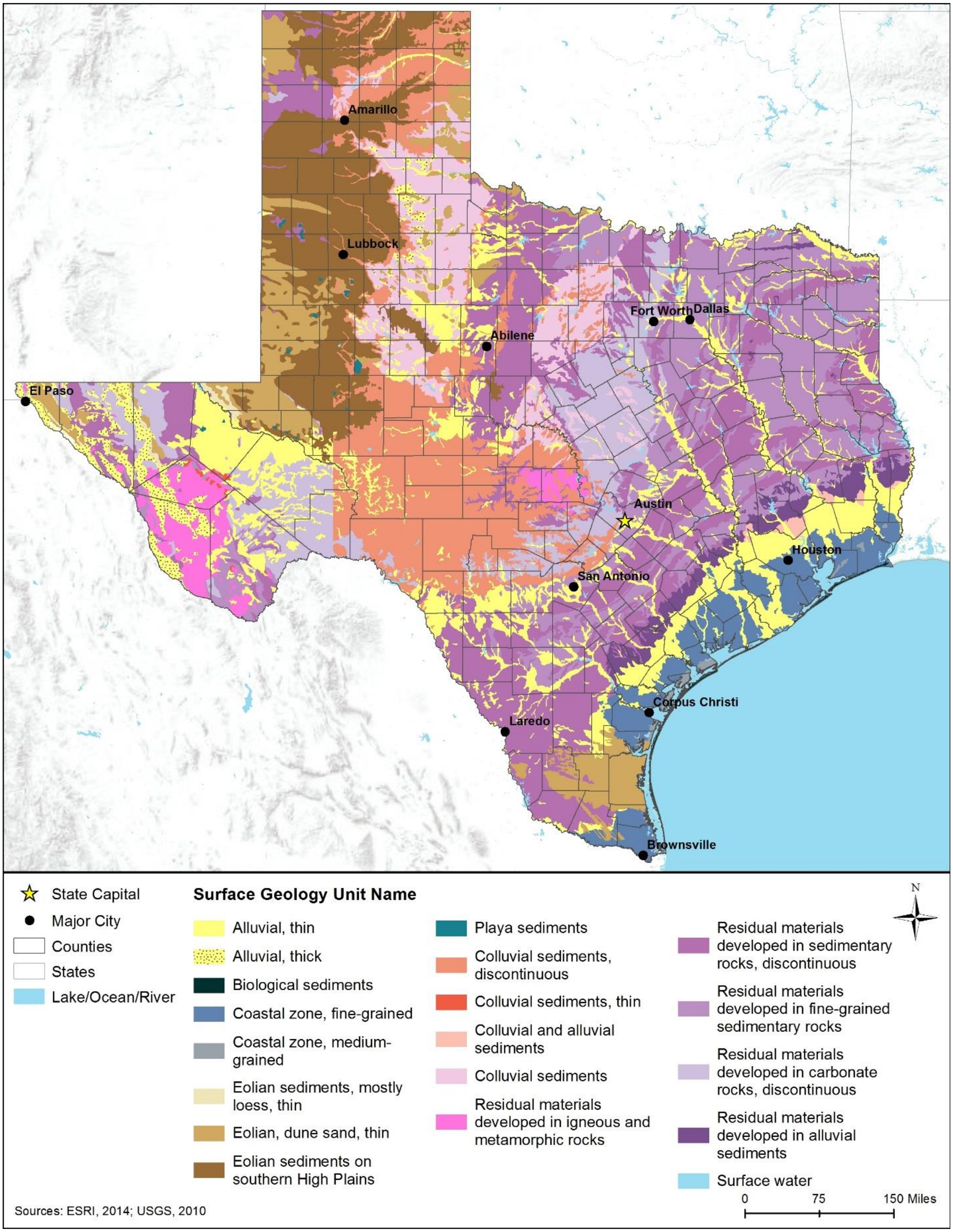


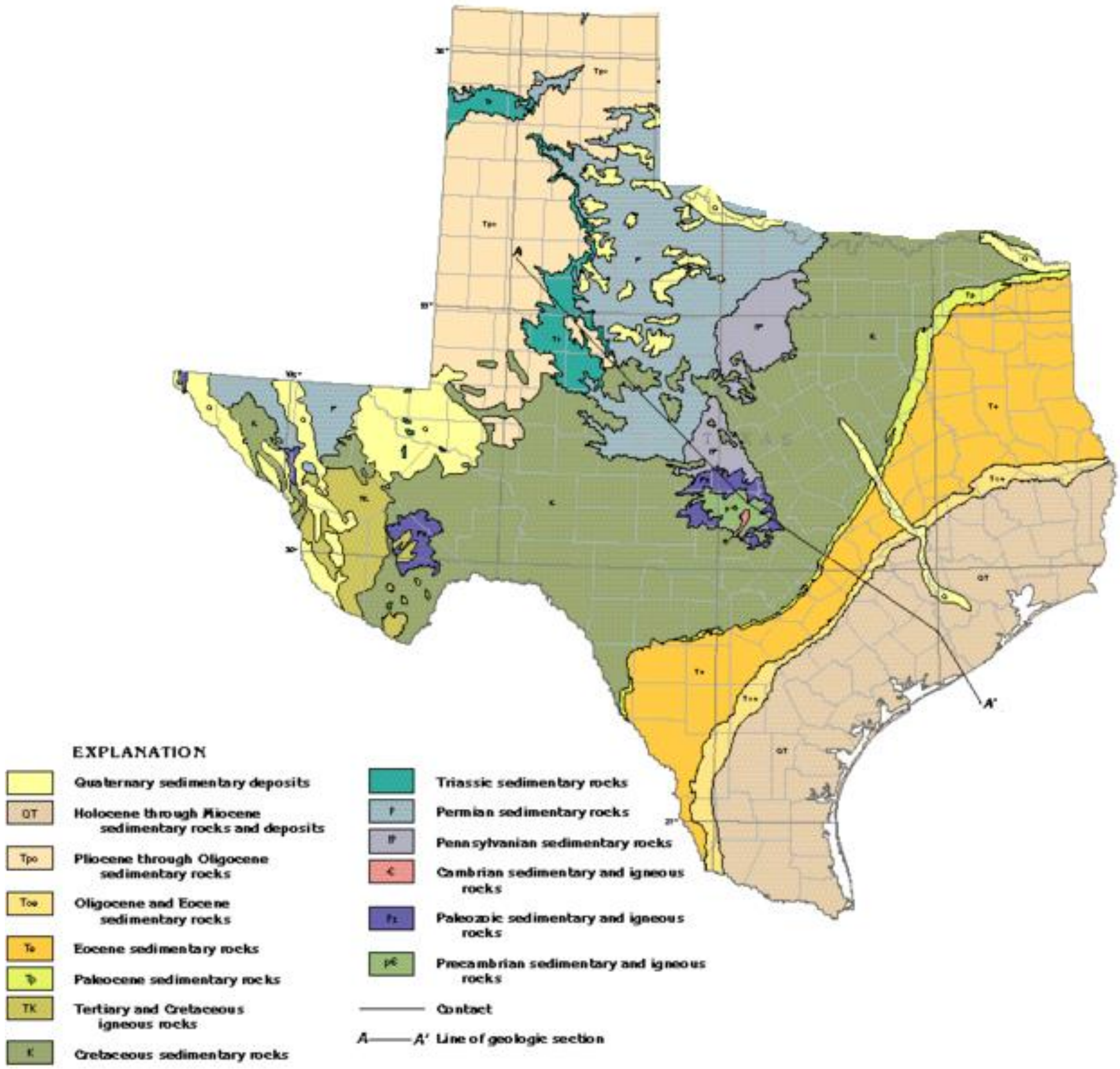
Figure 15.1.3-2: Generalized Surface Geology for Texas

15.1.3.5. Bedrock Geology

Bedrock geology (also known as structural geology) is "the study of distribution, position, shape, and internal structure of rocks" (USGS, 2015b) and reveals important information about a region's surface and subsurface characteristics (i.e., three dimensional geometry), including dip (slope of the formation),[40] rock composition, and regional tectonism.[41] 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 (NH DES, 2014).

The oldest rocks that underlie Texas are Precambrian igneous and sedimentary rocks that are at least 600 million years old. These rocks are exposed in areas of west Texas, as well as in the Llano Uplift in central Texas. Younger sedimentary and igneous rocks underlie most of Texas, formed from marine and river deposits and ancient volcanoes (Bureau of Economic Geology, 1992). Paleozoic (542 to 251 MYA) and Mesozoic (251 to 66 MYA) Era rocks are typically consolidated, while those from the Cenozoic Era (66 MYA to present) are usually semi-consolidated or unconsolidated. Outcrops of Paleozoic and Mesozoic rocks are found in central, northern, and western Texas, as well as in a coastal-parallel band on the Coastal Plain of Texas (USGS, 1996). Salt domes and ridges underlie east Texas, forming folded structures and oil and gas traps (Bureau of Economic Geology, 1992). Figure 15.1.3-3 displays the generalized bedrock geology for Texas.

[40] 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).
[41] Tectonisms: "Structure forces affecting the deformation, uplift, and movement of the earth's crust." (USGS, 2015g)



Source: (USGS, 1996)

Figure 15.1.3-3: Generalized Bedrock Geology for Texas

15.1.3.6. Paleontological Resources

Texas State Dinosaur: ***Paluxysaurus*** Source: (Netstate, 2009)

Texas was covered by a shallow sea throughout the Paleozoic Era (542 to 251 million years ago [MYA]), resulting in the preservation of Cambrian (542 to 488 MYA) marine fossils such as trilobites,[42] brachiopods,[43] bivalves,[44] sponges, gastropods,[45] and bryozoans.[46] This marine environment continued between the Ordovician (488 to 444 MYA) and Carboniferous (359 to 299 MYA) Periods and cephalopods,[47] gastropods, brachiopods, and coral fossils were recorded from this timeframe. Permian (259 to 251 MYA) outcrops have yielded both terrestrial and marine fossils, including a marine invertebrates and a few vertebrates in the Permian barrier reef in the Guadalupe Mountains. The Mesozoic Era (251 to 66 MYA) is represented by the fossil-rich Dockum Group shale and sandstone formations in Texas. The Cretaceous (146 to 66 MYA) Period saw fluctuating sea levels, resulting in the preservation of a diverse fossil assemblage, including early mammals (The Paleontology Portal, 2015). Texas' state dinosaur, Paluxysaurus, is a sauropod dinosaur that left fossilized footprints that can be seen at Dinosaur Valley State Park. (Netstate, 2009). Vertebrate fossils are common in early Cenozoic (66 MYA to present) rocks. Mammalian fossils, including bison, mammoths, and mastodons, are common in Quaternary (2.6 MYA to present) Period fossils (The Paleontology Portal, 2015).

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[42] 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).
[43] Brachiopod: "Any member of a phylum of marine invertebrate animals called Brachiopoda. Brachiopods are sessile, bivalved organisms, but are more closely related to the colonial Bryozoa than the bivalved mollusks. Brachiopod diversity peaked in the Paleozoic, but some species survive" (Smithsonian Institution, 2016).
[44] Bivalve: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing" (Smithsonian Institution, 2016).
[45] Gastropods: "Any member of a large class of mollusks (Gastropoda), commonly called snails. Gastropods live in marine, freshwater, and terrestrial habitats. They have a univalve, often spiral shell (or none at all), a muscular foot for locomotion, and distinctive sensory organs" (Smithsonian Institution, 2016).
[46] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies" (Smithsonian Institution, 2016).
[47] 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).

15.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2015, Texas led the nation in crude oil production with 1,263,585 million barrels of crude oil (EIA, 2017b). Texas produces crude oil from various geologic basins, most notably the Permian Basin in the western Texas. The Permian Basin contains 19of the top 100 oil-producing fields in the nation. Texas produces West Texas Intermediate (WTI) crude oil, which, is a high-quality, "low-gravity, low-sulfur crude oil, and it yields a large fraction of motor gasoline when refined." In October 2016, Texas produced 98,653 thousand barrels of oil, which accounted for 36.1 percent of total nationwide production (EIA, 2014a).

Texas currently leads the nation in natural gas production. "Almost one-third of the top 100 producing gas fields in the nation are located, in whole or in part, in Texas." Hydraulic fracking and horizontal drilling techniques led to an increase in production of natural gas. "Much of the last decade's rise in production is the result of drilling in the Barnett, Eagle Ford, and Haynesville-Bossier shale formations". In 2015, Texas produced 7,880,530 million cubic feet of natural gas from 142,368 natural gas producing wells. This level of production accounted for 27.4 percent of total nationwide natural gas production (EIA, 2014a).

Minerals

As of 2015, Texas' total nonfuel mineral production was valued at $4.8B. This level of production ranked 3rd nationwide (in terms of dollar value), and accounted for slightly less than 7 percent of the total nationwide production value. In 2015, Texas' leading nonfuel mineral commodities were portland cement, crushed stone, construction sand and gravel, industrial sand and gravel, and salt (USGS, 2016a). As of 2015, Texas ranked first nationwide in production of, industrial minerals and crushed stone.As of 2011, Texas was second nationwide in production of salt, construction sand and gravel, ball clay, crude talc. .[48] Other minerals produced in the state include bentonite, common clay, dimension stone, industrial sand, gypsum, sulfur, helium, , fire clay, fuller's earth, and kaolin, (USGS, 2015c).

In 2015, Texas produced 35,918 thousand short tons of coal. This level of production ranked 7th nationwide, and accounted for 4.0 percent of total nationwide production. Lignite[49] coal is produced in the Texas Gulf Coast region, while bituminous[50] coal is found in the north-central and southwestern portions of Texas (EIA, 2014a). Most bituminous coal in Texas is from Pennsylvanian (318 to 299 MYA) and early Permian (299 to 251 MYA) aged rocks (USGS, 1967).

[48] 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, 2016c)
[49] Lignite Coal: "A class of brownish-black, low-rank coal defined by the American Society for Testing and Materials as having less than 8,300 Btu on a moist, mineral-matter-free basis." (USGS, 2015h)
[50] Bituminous Coal: "A rank class of coals as defined by the American Society for Testing and Materials (ASTM) high in carbonaceous matter, having less than 86 percent fixed carbon, and more than 14 percent volatile matter on a dry, mineral-matter-free basis and more than 10,500 Btu on a moist, mineral-matter-free basis." (USGS, 2015h)

15.1.3.8. Geologic Hazards

The three major geologic hazards of concern in Texas are earthquakes, landslides, and subsidence. Volcanoes were considered but not analyzed further for Texas because they do not occur in Texas and therefore do not present a hazard to the state (USGS, 2015d). A discussion of each geologic hazard is included below.

Earthquakes

Areas of greatest seismicity in Texas are concentrated in the western portions of the state. During the 20th century, more than 100 earthquakes were felt throughout Texas, with four of these earthquakes measuring between magnitude 5.0 and 6.0 (on the Richter scale)[51] (Texas DPS, 2010). 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 both natural and manmade structures on the surface. Earthquakes can produce secondary flooding impacts resulting from dam failure (USGS, 2012a).

Spotlight: Texas' Largest Earthquake
The largest earthquake ever recorded in Texas was a magnitude 6.0 quake that occurred in 1931 near the town of Valentine in the western portion of the state. The earthquake caused extensive damage in Valentine and was felt as far away as Dallas. (UDC, 2017)

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 tectonic plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth. Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014e). 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 15.1.3-4 depicts the seismic risk throughout Texas; 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 (PGA)) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (percent g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 % g. (USGS, 2010)

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

According to the State of Texas Hazard Mitigation Plan, areas of the state that are most likely to experience a magnitude 5.5 to 6.0 earthquake within the next 50 to 100 years include western Texas (near El Paso) and the Texas Panhandle. “In northeastern Texas the greatest hazard is from very large earthquakes (magnitude 7 or above) which might occur outside of Texas, particularly in Oklahoma or Missouri-Tennessee. In south-central Texas the hazard is generally low, but residents should be aware that small earthquakes can occur there, including some which are triggered by oil or gas production.” Texas also may be affected by earthquakes emanating from other states such as the New Madrid Seismic Zone (in Missouri, Kentucky, Tennessee, and Arkansas) or earthquakes in Oklahoma. (Texas DPS, 2010)

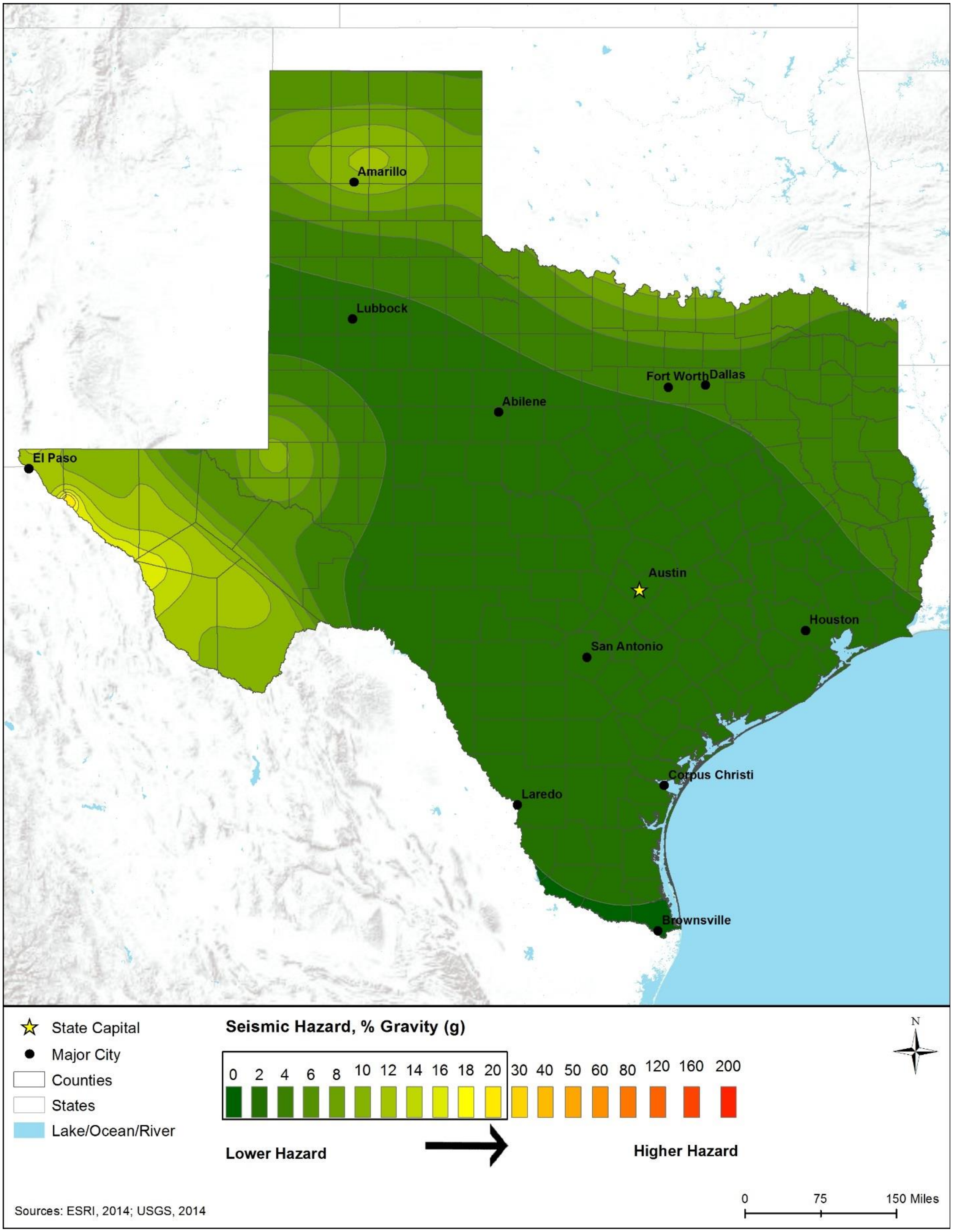


Figure 15.1.3-4: Texas 2014 Seismic Hazard Map

Landslides

The potential for landslides throughout Texas generally is minimal, with the exception a moderately to highly susceptible band along the border between the Atlantic Plain and Interior Plains Regions Figure 15.1.3-5. "The term 'landslide' describes many types of downhill earth movements, ranging from rapidly moving catastrophic rock avalanches and debris flows in mountainous regions to more slowly moving earth slides and other ground failures" (USGS, 2003a). Geologists use the term "mass movement" to describe a great variety of processes such as rock fall, creep, slump, mudflow, earth flow, debris flow, and debris avalanche regardless of the time scale (USGS, 2003a).

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

As noted above, portions of Texas are susceptible to landslides along the western edge of the Atlantic Plain Province. "Along the western Gulf-Atlantic Rolling Plain in Texas and in the disturbed belt along the front of the Stockton-Balcones Escarpment[52] and northward, clay-rich Cretaceous [(146 to 66 MYA)] deposits are susceptible to slumping and sliding, even on gentle slopes. Notable among these deposits are the Del Rio Clay, the Taylor and Navarro Groups, and the Eagle Ford Formation." Clay deposits on the Gulf Coast (near Houston) are also among Texas' most landslide-prone areas (Radbruch-Hall, et al., 1982). Figure 15.1.3-5 shows landslide incidence and susceptibility throughout Texas.

Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials" (USGS, 2000). Within Texas, the primary causes of subsidence are aquifer compaction and karst[53] topography. Nationwide, the primary causes of land subsidence are attributed to aquifer system compaction (both natural and hydrocompaction), drainage of organic soils, underground mining, sinkholes, and thawing permafrost (although not a concern in Texas). More than 80 percent of subsidence in the U.S. 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.

[52] Escarpment: "A cliff formed by faulting, erosion, or landslides" (USGS, 2015g).
[53] Karst: "A distinctive landscape (topography) that can develop where the underlying bedrock, often limestone or marble, is partially dissolved by surface or ground water" (USGS, 2015g).

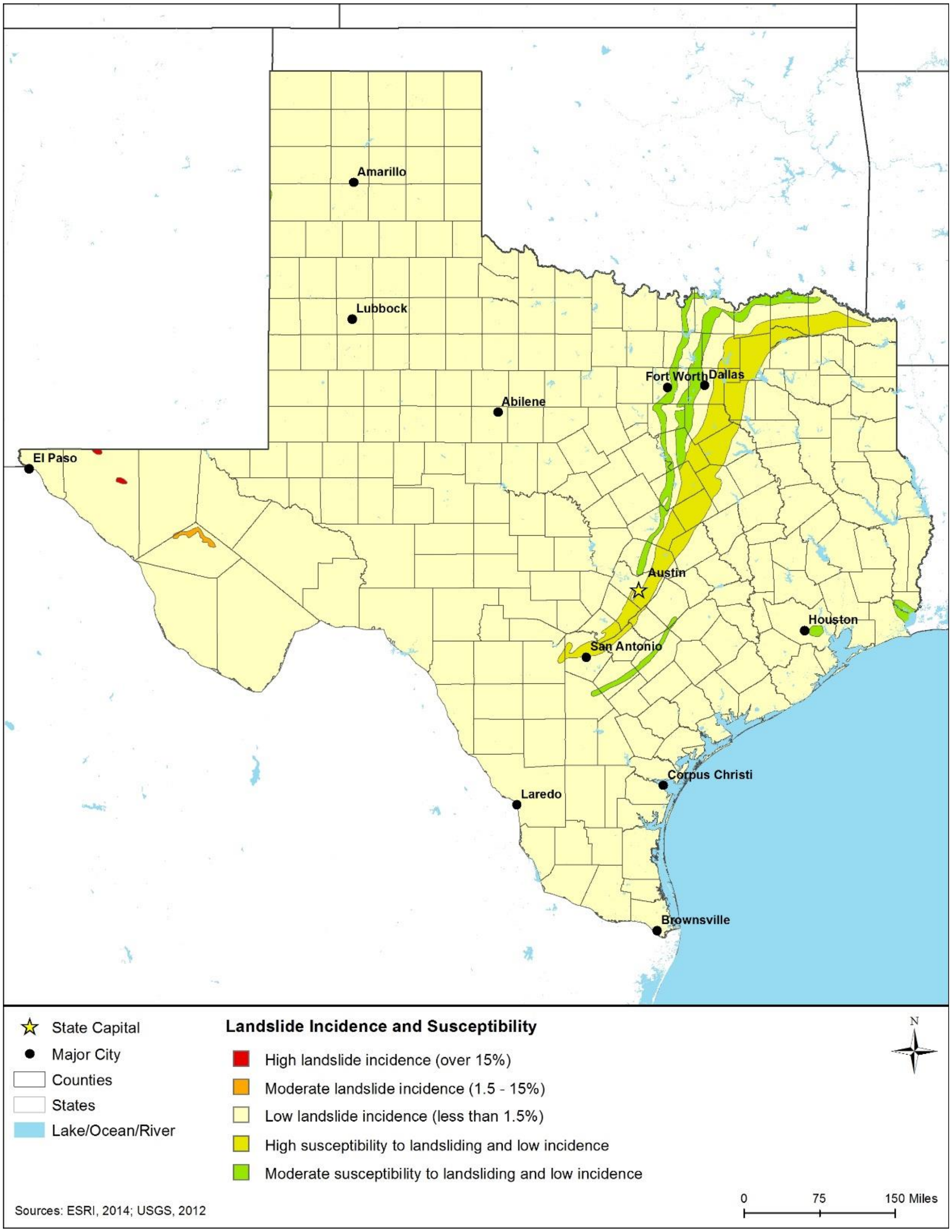


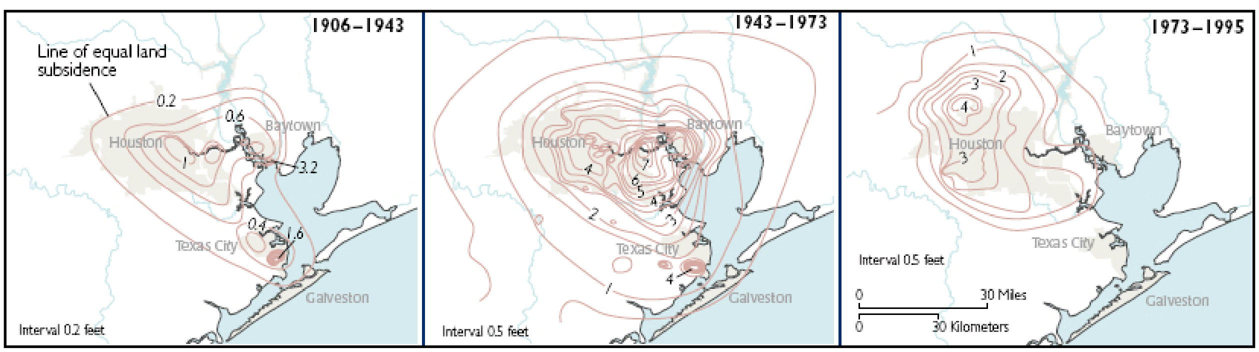
Figure 15.1.3-5: Texas Landslide Incidence and Susceptibility Hazard Map[54]

[54] Susceptibility hazards not indicated in Figure 15.1.3-5 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014i)

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, 2013a).

In southeastern Texas, greater Houston has been adversely affected by land subsidence due to aquifer compaction, resulting in sea level rise of 2 millimeters per year. The primary causes are attributed to groundwater and oil and gas withdrawals. In some areas, land elevation has dropped by 3 meters, resulting in coastline shifts and re-distribution of wetlands and aquatic vegetation. More than 100 acres of the San Jacinto Battleground State Historical Park are now under water due to subsidence. In Galveston Bay, "more than 26,000 acres of emergent wetlands have been converted to open water and barren flats". Some bay shorelines have become more susceptible to erosion by wave action due to loss of fringing wetlands. Figure 15.1.3-6 shows the progression of land subsidence in the greater Houston metropolitan area between 1906 and 1995. (USGS, 2007)



Source: (USGS, 2007)

Figure 15.1.3-6: Land Subsidence in Houston, TX (1906-1995)

Southwestern Texas is at risk of experiencing land subsidence due to the presence of karst topography. Much of southwestern Texas is underlain by the Edwards-Trinity aquifer system, which is composed of Cretaceous (146 to 66 MYA) carbonate[55] rocks (USGS, 1996). Caves are common features of the landscape throughout southwestern Texas' Edwards Plateau (USGS, 2012b). Figure 15.1.3-7 displays the areas of Texas that are susceptible to subsidence due to karst topography.

[55] Carbonate: "A sedimentary rock made mainly of calcium carbonate ($CaCO_3$). Limestone and dolomite are common carbonate sedimentary rocks" (USGS, 2015g).

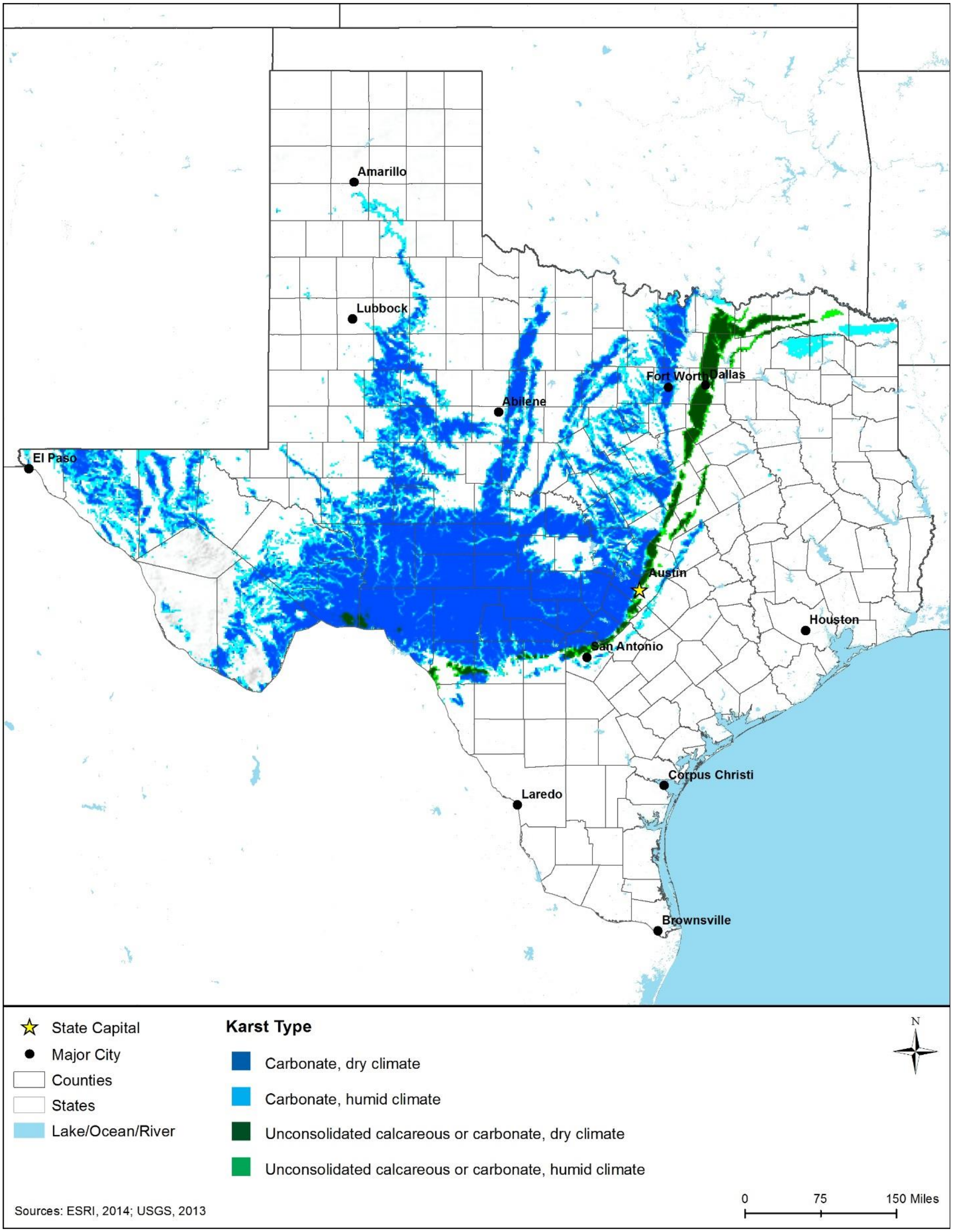


Figure 15.1.3-7: Areas Susceptible to Subsidence due to Karst Topography in Texas

15.1.4. Water Resources

15.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 15.1.5). 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, 2014f)

15.1.4.2. 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 15.1.4-1: Relevant Texas Water Resources Laws and Regulationssummarizes the major Texas laws and permitting requirements relevant to the state's water resources.

Table 15.1.4-1: Relevant Texas Water Resources Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
Clean Water Act (CWA) Section 404 Nationwide Permits (NWPs), Texas regional requirements	U.S. Army Corps of Engineers (USACE) Fort Worth/Galveston Districts	Regional conditions apply to activities authorized by USACE NWPs in Texas.
CWA Section 401 Water Quality Certification	Texas Commission on Environmental Quality (TCEQ)	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 TCEQ indicating that the proposed activity will not violate water quality standards.
Texas Pollutant Discharge Elimination System (TPDES) Program	TCEQ	Regulates the discharge of pollutants in storm water discharges associated with small and large construction activities that disturb one or more acres. TPDES permits also regulate point source discharges from industrial and municipal wastewater treatment.

Sources: (TCEQ, 2004), (TCEQ, 2017a), (TCEQ, 2017b)

15.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine[56] and coastal waters. According to the Texas Water Development Board (TWDB), Texas has approximately 191,000 miles of rivers and streams, 196 major reservoirs, and approximately 367 miles of coastline (TWDB, 2015a) (TWDB, 2015b). These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, agriculture, fishing, power generation, and industry across the state (TWDB, 2012).

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). Texas' waters (lakes, rivers, and streams) are divided into 23 major watersheds, or drainage basins (Figure 15.1.4-1) (TCEQ, 2015j).

The Canadian River Basin covers the northernmost portion of Texas, draining an area that flows toward the Arkansas River in Oklahoma. South of this basin is the Red River Basin, extending along the Texas-Oklahoma border and including one of the Texas' largest lakes, Lake Texoma. The Brazos and Colorado River basins drain the majority of central Texas, extending from the northwestern border of Texas to the southeastern coastal basins. East of the Brazos River Basin is the Trinity River Basin, which drains a large portion of northcentral Texas. The Sulphur River, Cypress River, Sabine River, and Neches River basins drain the entire area along the eastern Texas border. The Nueces-Rio Grande Coastal Basin drains an approximate area of 10,442 square miles in the southernmost portion of Texas between the Nueces and Rio Grande rivers (TCEQ, 2002). Northeast of this basin, along the coastline are the San Antonio-Nueces, Lavaca-Guadalupe, and Colorado-Lavaca Coastal basins. Additionally, the Brazos-Colorado, San Jacinto-Brazos, and Trinity-San Jacinto Coastal basins encompass the majority of the eastern half of the coastline. The remaining coastal basin, the Neches-Trinity, drains a small area of approximately 769 square miles in the far southeastern portion of the Texas coastline. In western Texas, the Rio Grande River Basin is the largest basin in the state and drains approximately 48,259 square miles. The river basin includes several major reservoirs, including Lake Amistad. (TWDB, 2017a)

Freshwater

As shown in Figure 15.1.4-1, there are 12 major rivers in Texas: Brazos, Canadian, Colorado, Guadalupe, Neches, Nueces, Pecos, Red, Rio Grande, Sabine, San Antonio, and Trinity. In western Texas, the Rio Grande River forms the boundary between Texas and Mexico, flowing from El Paso to the Gulf of Mexico. The Colorado River flows through central Texas and is the second longest river located entirely within the state (TWDB, 2015c). The Brazos River is located east of the Colorado River, and flows from northcentral Texas south to the Gulf of

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

Mexico. (TWDB, 2017b) North of these rivers is the Red River, which flows from New Mexico across Texas, and forms the Texas-Oklahoma border (TWDB, 2015d).

Texas also contains more than 200 major reservoirs, varying in size from approximately 5,200-acre-feet storage capacity to 4,472,900 acre-feet. Major lakes and reservoirs in Texas include Lake Amistad, Lake Texoma, Sam Rayburn Reservoir, and Toledo Bend Reservoir (TWDB, 2015a) (Figure 15.1.4-1).

- Lake Amistad, or Amistad Reservoir, covers an approximate area of 63,680 acres in west Texas along the Texas-Mexico border on the Rio Grande River. The reservoir was constructed for irrigation and hydroelectric power generation but is often used by residents and visitors for various recreational activities, such as fishing (TPWD, 2014a).
- Lake Texoma, or Texoma Reservoir, is approximately 74,686 acres located on the Red River between Texas and Oklahoma (TPWD, 2012). Initially, the reservoir was constructed for flood control, hydropower, and water supply. The reservoir is now a popular recreational site for visitors and local residents. (USACE, 2015a)
- Sam Rayburn Reservoir encompasses approximately 111,422 acres in east Texas (TPWD, 2014b). The reservoir provides flood control to river basins in southeast Texas, such as the Neches River Basin; offers many recreational opportunities, such as fishing and boating for Texas residents; and acts as a water supply for local Texas residents (USACE, 2014).
- Toledo Bend Reservoir has approximately 70,469 acres within southeast Texas on the Sabine River. The reservoir was constructed for industrial, municipal, and agricultural water supply, in addition to recreation, such as fishing and boating, and hydropower production (TPWD, 2013).

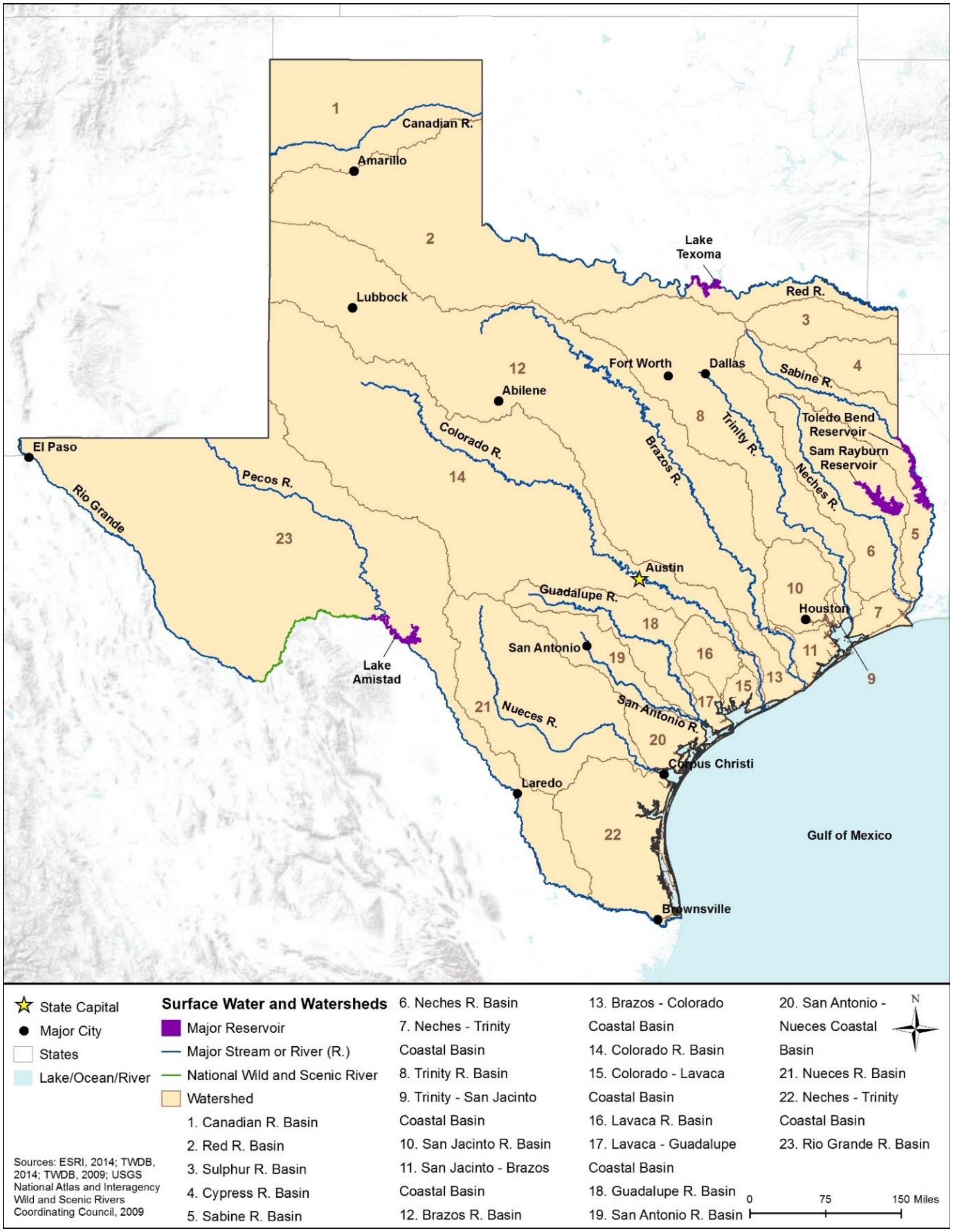


Figure 15.1.4-1: Major Texas Watersheds and Surface Waterbodies

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, sand bars, and other landmasses protect estuaries, including those in Texas, from ocean waves and storms. Texas' 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 life cycle of many different plant and animal species (USEPA, 2012a).

Texas has seven major estuarine areas (Figure 15.1.4-2): Sabine-Neches, Trinity-San Jacinto, Colorado-Lavaca, Guadalupe, Mission-Aransas, Nueces, and Laguna Madre. These estuaries are named for their primary contributing rivers. (TWDB, 2017c)

- The **Sabine-Neches Estuary**, also referred to as Sabine Lake, is in northeastern Texas, along the Texas-Louisiana border. The estuary is the smallest of the seven major estuaries, encompassing approximately 45,320 acres. (TWDB, 2015e)
- The **Trinity-San Jacinto Estuary**, also referred to as Galveston Bay, is in northeastern Texas, southwest of the Sabine-Neches Estuary. The Trinity-San Jacinto is the largest estuary in Texas and is approximately 345,280 acres. (TWDB, 2015f)
- The **Colorado-Lavaca Estuary**, also referred to as Matagorda Bay, is along the upper-mid Texas coast. The estuary is approximately 244,490 acres in size and is the second largest estuary in Texas. (TWDB, 2015g)
- The **Guadalupe Estuary**, also referred to as the San Antonio Bay, is located on the mid-Texas coast. The estuary is approximately 143,000 acres and does not typically drain into the Gulf of Mexico, except through a bayou (river outlet) occasionally opened by tropical storms (TCEQ, 1981) (TWDB, 2015h).
- The **Mission-Aransas Estuary** is southwest of the Guadalupe Estuary, in the coastal bend of Texas. The estuary covers 111,780 acres and drains into the Gulf of Mexico. (TWDB, 2015i)
- The **Nueces Estuary** is also in the coastal bend region, southwest of the Mission-Aransas Estuary. The estuary encompasses approximately 106,990 acres and drains into the Gulf of Mexico. (TWDB, 2015j)
- The **Laguna Madre Estuary** is located along the lower coast of Texas, extending toward the Texas-Mexico border. The estuary is approximately 280,910 acres and drains into the Gulf of Mexico. (TWDB, 2015k)

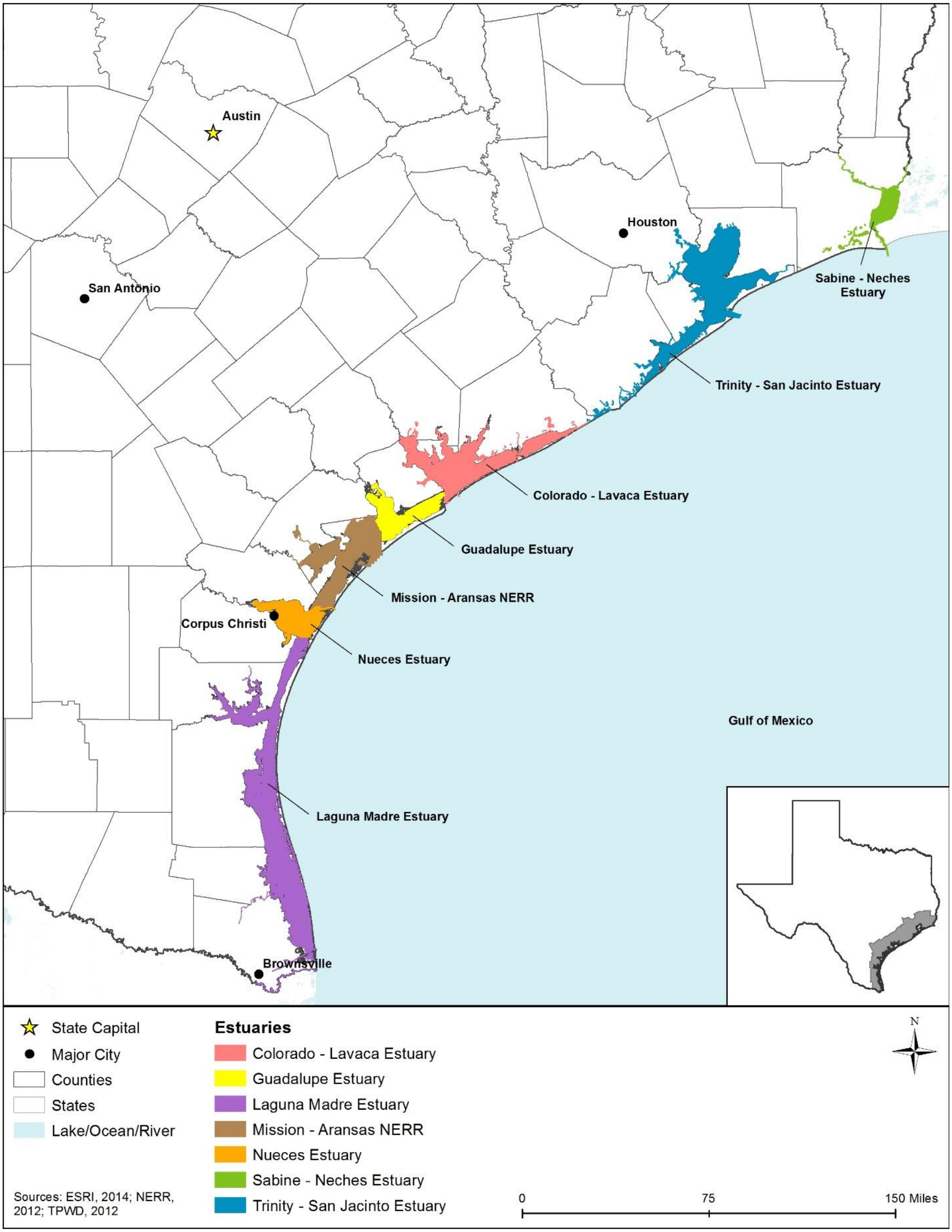


Figure 15.1.4-2: Texas' Estuaries and Critical Resource Waters

15.1.4.4. Sensitive or Protected Waterbodies

The Rio Grande River is a federally designated National Wild and Scenic River in Texas (Figure 15.1.4-1). The 191-mile stretch of the river includes approximately 95 miles designated as wild and 96 miles designated as scenic. The Rio Grande River flows through "isolated, rugged canyons" along the Texas-Mexico border and includes "some of the most critical wildlife habitat in the country." (National Wild and Scenic Rivers System, 2015a)

15.1.4.5. 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,[57] the causes of impairment, and probable sources.

Table 15.1.4-2 summarizes the water quality of Texas' assessed major waterbodies by category, percent impaired, designated use,[58] cause, and probable sources. Figure 15.1.4-3 shows the Section 303(d) waters in Texas, as of 2014.

Various sources affect Texas' waterbodies, causing impairments. Mercury and pathogens[59] are the two primary causes of impairment for waters along the Gulf Coast shoreline. Elevated levels of mercury in certain species of fish have resulted in a Saltwater Fish Consumption Advisory for all Texas Coastal Waters (TPWD, 2015d). Additionally, organic enrichment, salinity (salt content), polychlorinated biphenyls, and pathogens are causes for impairment in assessed rivers and streams within Texas. Pathogens within the Sabine River Tidal area are caused by various sources, including combined sewer overflows, industrial point source discharge, and municipal runoff from high-density areas (TCEQ, 2014a).

[57] 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)
[58] 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)
[59] Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015c).

Table 15.1.4-2: Section 303(d) Impaired Waters of Texas, 2010

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	12%	44%	aquatic life, fishing, general use, and recreation	organic enrichment, salinity/chlorides, polychlorinated biphenyls (PCBs), and pathogensc	municipal point source discharges/sewage, wildlife, urban-related runoff storm water, and agriculture
Lakes, Reservoirs, and Ponds	73%	38%	aquatic life, fishing, general use, and recreation	mercury, salinity/chlorides, pH/acidity, organic enrichment	atmospheric deposition,d municipal point source discharges/sewage, and wildlife
Estuaries and Bays	100%	28%	aquatic life, fishing, oyster propagation, and primary contact recreation	dissolved oxygen, dioxins, PCBs, pathogens, and metals	industry, urban runoff/storm sewers, and municipal point source discharges/sewage
Gulf coastal shoreline	388 miles (total coastal shoreline not available)	100%	fishing and primary contact recreation	mercury and pathogens	atmospheric deposition and unknown sources
Ocean and near coastal	75 miles (total Ocean and near coastal miles not available)	91%	fishing	mercury	atmospheric deposition and unknown sources

Source: (USEPA, 2010a)

[a] Some waters may be considered for more than one water type.
[b] Texas has not assessed all waterbodies within the state.
[c] Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015c).
[d] Atmospheric deposition: the process by which airborne pollutants settle onto to the earth's surface and pollutants travel from the air into the water through rain and snow ("wet deposition"), falling particles ("dry deposition"), and absorption of the gas form of the pollutants into the water (USEPA, 2015c).

Statewide, the primary designated uses for Texas' impaired waterbodies are aquatic life, fishing, and recreation. The Texas Commission on Environmental Quality (TCEQ) works closely with federal and state agencies to ensure designated uses of Texas waterbodies are preserved. For example, water quality monitoring is conducted by TCEQ and other organizations to provide efficient water quality data collection across the state. Programs, such as the Clean Rivers Program are established in Texas to create partnerships between TCEQ, regional water authorities, and the public. Water authorities manage this program to maintain water quality data, coordinate monitoring efforts, and facilitate public participation within each basin (TCEQ, 2015k). Additionally, water pollution caused by urban and other nonagricultural nonpoint sources impact Texas waterbodies causing impairment. TCEQ has implemented the Nonpoint Source Program to clean and prevent further pollution of the state's waters (TCEQ, 2015l).

15.1.4.6. 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] Part 59.1) (FEMA, 2000).[60] 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 Texas.

- **Riverine and lake floodplains** occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In steep river valleys found in hilly areas, such as central Texas, 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 Texas are found along the Gulf of Mexico coastline. Coastal flooding can occur when strong wind and storms, and hurricanes, increase water levels on the adjacent shorelines (FEMA, 2013). In addition, a storm surge event that takes place during high tide can cause floodwaters to exceed normal tide levels, resulting from strong winds preventing tidal waters to recede in conjunction with additional water pushed toward the shore, as was the case during Hurricane Ike (NOAA, 2015a).

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

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 Texas, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include severe rain events, hurricanes and tropical storms, over-development/impervious[61] surfaces, and dam failure (Texas Department of Emergency Management, 2013).

Few areas within Texas are completely free from flood threats. Approximately 83 federally declared disasters have occurred in Texas from 1953 to 2010, including 30 declarations due to flooding. Historically, floods have constituted over 90 percent of disaster damage experienced in Texas. Based on historical flooding and flood disaster declarations, flood problems are most severe along the coast and in Central Texas. On average, Texas suffers 400 floods and approximately $254 million in losses each year. (Texas Department of Emergency Management, 2013)

Hurricane Ike

In September 2008, Hurricane Ike made landfall over the Texas coast on the north end of Galveston Island. The hurricane's storm surge, winds, and flooding from heavy rains caused mass damage in southeastern Texas, western Louisiana, and Arkansas. Property damage was estimated at $19.3B. (Texas Department of Emergency Management, 2013) Storm surges of 15-20 feet above normal tide levels occurred in areas along the Texas coastline, and rainfall amounts were as much as 19 inches in southeastern Texas (NOAA, 2015a).

Source: (FEMA, 2014e)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 1,243 communities in Texas through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Texas had 63 communities participating in the CRS (FEMA, 2014d).[62]

[61] 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).
[62] A list of the 63 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014d)and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

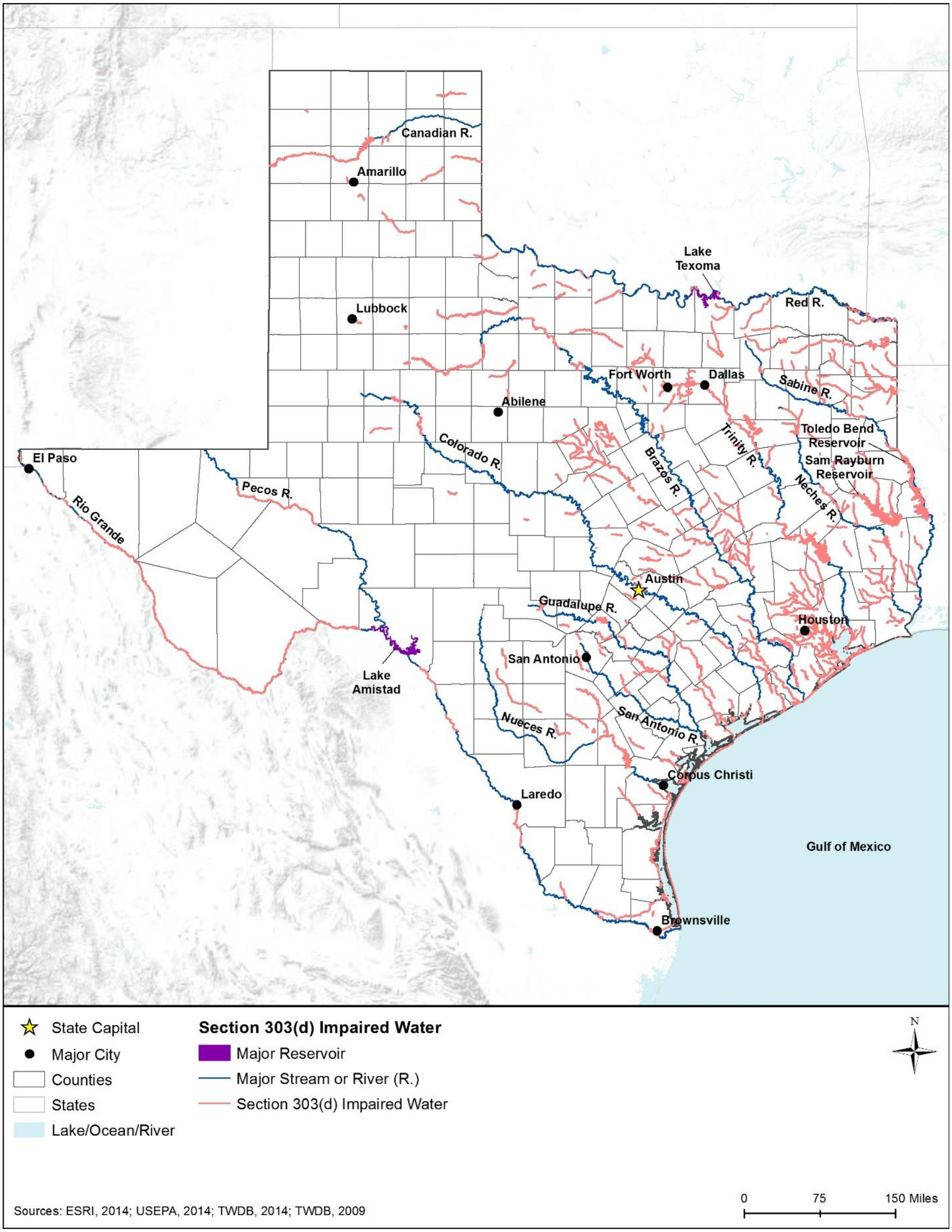


Figure 15.1.4-3: Section 303(d) Impaired Waters of Texas, 2014

15.1.4.7. 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). Table 15.1.4-3: provides details on aquifer characteristics in the state; Figure 15.1.4-4: shows Texas' principal and sole source aquifers.

Texas' principal aquifers consist of carbonate-rock[63] and sandstone aquifers.[64] Approximately 59 percent of water used in Texas is supplied by groundwater sources. Generally, the water quality of Texas' aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include naturally occurring elevated levels of total dissolved solids, arsenic, and radionuclides (radium, uranium, and radon gas), and elevated nitrate levels from human activities, such as overuse of fertilizers and improper disposal of human and animal waste. (George, Mace, & Petrossian, 2011)

Sole Source Aquifers

The U.S. Environmental Protection Agency (USEPA) defines sole source aquifers (SSAs) as "an aquifer that supplies at least 50 percent of the drinking water consumed in the area overlying the aquifer" and are areas with no other drinking water sources (USEPA, 2015d). Texas has two SSA designations within the state (as shown in Figure 15.1.4-4:). Edwards I SSA and Edwards II SSA are located between the cities of Austin and San Antonio and areas to the west. Groundwater from these SSA areas supplies more than 1.5 million people in southcentral Texas (USGS, 2014g). Designating a groundwater resource as an SSA helps to protect the drinking water supply in that area and requires reviews for all federally funded proposed projects to ensure that the water source is not jeopardized (USEPA, 2015d).

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

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

Table 15.1.4-3: Description of Texas' Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Blaine aquifer consists of red silty shale, gypsum and anhydrite (sedimentary rock minerals), and dolomite.	Located at the east end of the High Plains area in north Texas	Water quality is poor. Most water is moderately saline, with elevated total dissolved solids and sulfates. Water is used for domestic, livestock, municipal, industrial, and irrigation purposes.
Coastal Plain aquifer system (Coastal lowlands aquifer system and Texas coastal uplands aquifer system) consists of sand, silt, clay, and gravel.	Extends from the Texas-Louisiana border in the east to the border of Mexico in the southwest in a wide band that parallels the Gulf of Mexico	Water quality varies with depth and locality. Water is generally good in the central and northeastern parts of the aquifer, with quality declining to the south. Water is used for municipal, industrial, and irrigation purposes. Texas coastal uplands aquifer system is hard, but generally fresh, with softer water occurring near the subsurface. Iron and manganese occur in the deeper subsurface.
Edwards-Trinity aquifer system consists of limestone, dolomite, sands, clays, and gravels.	Extends across the southcentral and southwestern portion of Texas with an additional band that extends across central and northeast Texas	Water quality ranges from fresh to moderately saline. Water is characterized as hard and increases in salinity to the west. Elevated levels of fluoride exist in some areas. Sulfate and chloride concentrations increase with depth. Water uses include municipal, irrigation, livestock supplies, and recreation.
High Plains aquifer consists of sand, gravel, clay, and silt.	Covers the Texas Panhandle (northernmost portion of Texas)	Water in the northern portion is generally fresh; however, quality diminishes toward the south. Elevated arsenic, radionuclides, and fluoride are present in some areas. Most of the water is used for irrigated agriculture.
Pecos River Basin alluvial aquifer consists of sand, silt, or gravel sediments.	Located in west Texas	Water quality if highly variable with water being typically hard. Aquifer is characterized by high levels of chloride and sulfate and has elevated arsenic and radionuclides levels. Water is primarily used for irrigation. Other uses include municipal supplies, industrial use, and power generation.
Rio Grande aquifer system consists of silt, sand, gravel, and clay.	Located in far west Texas, east and west of the Franklin Mountains	Water is fresh to slightly saline, with salinity increasing toward the south and shallower parts of the aquifer. Most of the water is used for public supply.
Seymour aquifer consists of gravel, sand, and silty clay.	Extends across northcentral Texas	Generally, the water is suitable for most uses, including drinking water. Iron concentrations are locally high, and the water is slightly acidic. Because of the proximity to the marine coast, localized heavy pumping can cause saltwater intrusion (movement into the freshwater aquifer).

Sources: (TWDB, 2015l) (TWDB, 2015m) (TWDB, 2015n) (TWDB, 2015o) (TWDB, 2015p) (TWDB, 2015q) (TWDB, 2015r) (TWDB, 2015s)

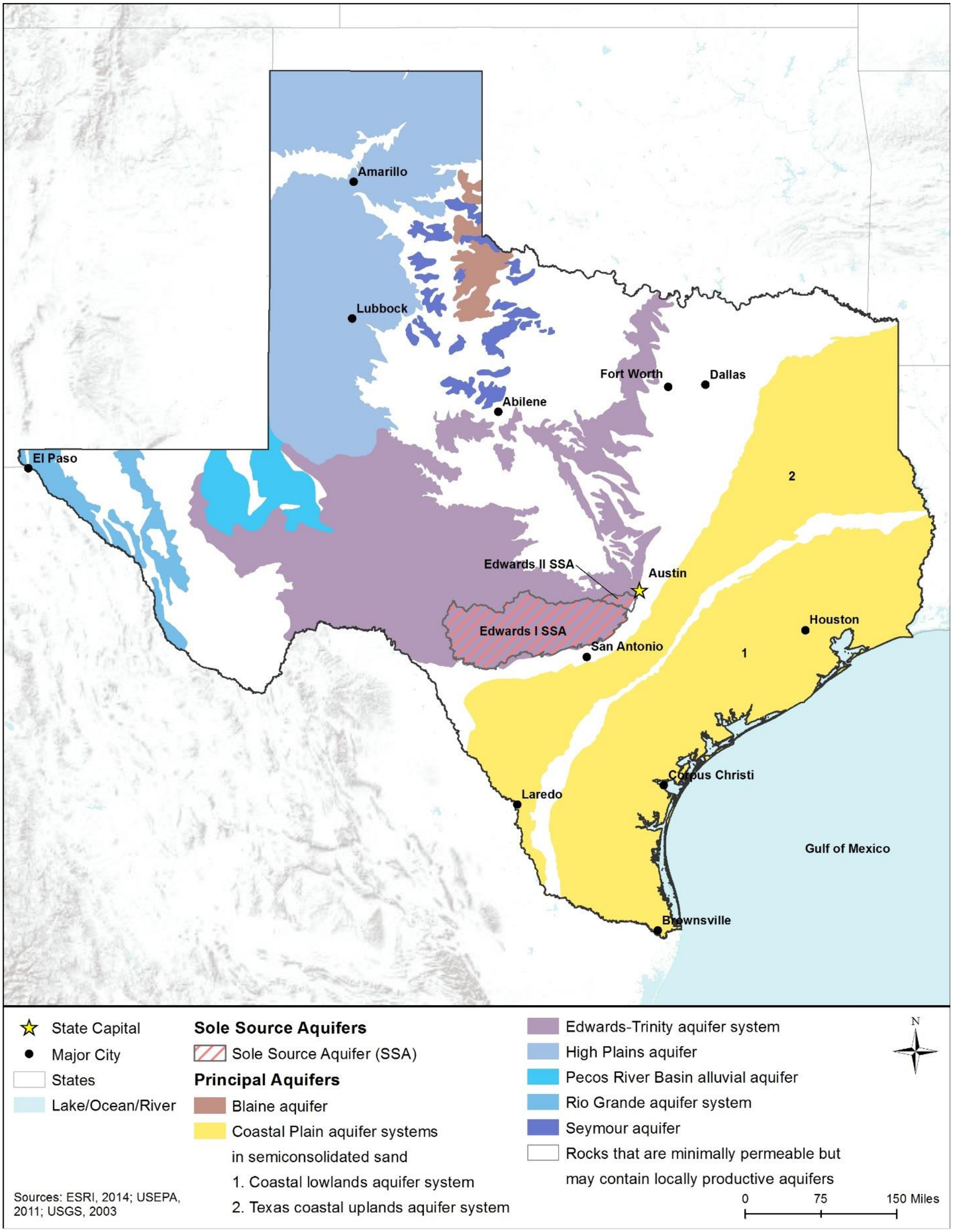


Figure 15.1.4-4: Principal and Sole Source Aquifers of Texas

15.1.5. Wetlands

15.1.5.1. Definition of the Resource

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

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

15.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 15.1.5-1 summarizes the major Texas state laws and permitting requirements relevant to the state's wetlands.

Table 15.1.5-1: Relevant Texas Wetlands Laws and Regulations

State Law/Regulation	Regulatory Authority	Applicability
CWA Section 404 NWPs, Texas regional requirements	USACE Fort Worth/Galveston Districts	Regional conditions apply to activities authorized by USACE NWPs in Texas. Additional review is required for pitcher plant bogs, swamps dominated by bald cypress and tupelo gum tree species, Caddo Lake (designated as a Ramsar Wetland of International Importance), mangrove marshes, and coastal dune swales.
CWA Section 401 Water Quality Certification	TCEQ	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 TCEQ indicating that the proposed activity will not violate water quality standards.
TPDES Program	TCEQ	Regulates the discharge of pollutants in storm water discharges associated with small and large construction activities that disturb one or more acres.

Source: (TCEQ, 2004), (TCEQ, 2017a), (TCEQ, 2017b)

15.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined by (Cowardin, Carter, Golet, & LaRoe, 1979). The Wetlands Classification System includes five major wetland Systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. Texas includes three of these Systems, as detailed in Table 15.1.5-2. 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 open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 percent salty) water chemistry; minimal influence from rivers or estuaries" (Cowardin, Carter, Golet, & LaRoe, 1979). 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" (Cowardin, Carter, Golet, & LaRoe, 1979).
- "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." (Cowardin, Carter, Golet, & LaRoe, 1979).
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent" (Cowardin, Carter, Golet, & LaRoe, 1979). 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)

"Although wetlands comprise less than five percent of its total land area, Texas has the fourth greatest wetland acreage in the lower 48 states (following Florida, Louisiana and Minnesota)" (TPWD, 1997). In Texas, palustrine (freshwater) wetlands found on river and lake floodplains across the state (mostly on the eastern half of the state), are the main type of wetlands, as shown in Figure 15.1.5-1, Figure 15.1.5-2:, and Figure 15.1.5-3. There are approximately 410,000 acres of estuarine wetlands in Texas (USFWS, 2014a). Riverine and lacustrine wetlands, as defined in Table 15.1.5-2 comprise approximately four percent of the wetlands in the state. Therefore, they are not discussed in this PEIS.

Table 15.1.5-2: uses 2014 NWI data to characterize and map Texas wetlands on a broad-scale.[65] The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work, at the site-specific level once those locations are known, at the site-specific level once those locations are known. As shown in Figure 15.1.5-1, Figure 15.1.5-2, and Figure 15.1.5-3, palustrine wetlands are found across the entire state, while estuarine/marine wetlands are found in the southern portion of the Texas along the Gulf Coast. The map codes and colorings in Table 15.1.5-2: correspond to the wetland types in the figures.

Table 15.1.5-2: Texas Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	**PFO**	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Predominantly within the eastern part of the state, often on forested lowlands within the state	2,147,771
Palustrine scrub-shrub wetland	**PSS**	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Predominantly within the eastern part of the state, often on forested lowlands within the state	
Palustrine emergent wetlands	**PEM**	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens,[66] prairie potholes, and sloughs.	Southeastern part of the state	1,261,990
Palustrine unconsolidated bottom	**PUB**	PUB and PAB wetlands are commonly known as freshwater ponds, and includes all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Southeastern part of the state along the Gulf Coast	440,496
Palustrine aquatic bed	**PAB**	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		

[65] 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.
[66] Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water (Edinger, et al., 2014).

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep[67], and other miscellaneous wetlands are included in this group.	Throughout the state	185,084
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	116,841
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	397,573
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.	Southeastern part of the state along the coastline	410,677
			Total	**4,960,432**

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

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

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

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

Palustrine Wetlands

In Texas, palustrine wetlands include the majority of vegetated freshwater wetlands (forested wetlands, freshwater marshes, swamps, and ponds). Palustrine forested wetlands (PFO) are found throughout the state and are the most common type of palustrine wetlands within Texas. Common types of PFO in Texas include bottomland hardwoods and swamps. Palustrine scrub-shrub wetlands (PSS) occur throughout Texas, usually found in previously disturbed areas. Common vegetative species in Texas PSS are water elm (*Ulmus americana*), buttonbush (*Cephalanthus occidentalis*), and swamp privet (*Forestiera acuminata*). Palustrine emergent wetlands (PEM) (or freshwater marshes) found in Texas include wet prairies,[68] floodplain marshes, and bogs.[69] Texas marshes occur in shallow water along the northern boundary of coastal marshes, and along coastal bays, and support diverse plant and animal species. Common marsh plants in Texas include cattail (*Typha latifolia*), sedges (*Eleocharis* spp.), giant cutgrass (*Zizaniopsis miliacea*), maidencane (*Panicum hemitomon*), and American lotus (*Nelumbo lutea*). PEM are common in the southern part of the state and along the coastline. (TPWD, 1997)

Other types of palustrine wetlands found in Texas include depressional and spring-fed wetlands. Depressional wetlands, such as coastal potholes found in southern Texas and playa lakes found in the High Plains of eastern Texas, occur in shallow depressions that fill from spring or fall precipitation, and are usually dry by late summer or during droughts since they are not connected to a permanent water source. Depressional wetlands fill from rain, snowmelt, or groundwater. These small wetlands contribute to storage and filtration of surface water and help recharge aquifers. Approximately 19,300 playas are found in Texas, covering 2 percent of the region's landscape. (TPWD, 1997) (TPWD, 2015e)

Seeps and springs occur where groundwater flows from cracks or openings in the rock or soil. These wetlands are found throughout the limestone formations of central Texas and in the mountainous areas of western Texas. Ciénegas, or desert marshes, are also a type of spring-fed wetland that occur in the desert areas of West Texas. "Most cienegas today; however, have been lost by water mining, water diversion or overgrazing." (TPWD, 1997)

Based on the USFWS NWI 2014 analysis, there are currently approximately 4 million acres of palustrine (freshwater) wetlands in the state. Of those, PFO/PSS wetlands are the dominant wetland type (53 percent), followed by PEM wetlands (31 percent), PUB/PAB (ponds) (11 percent), and other palustrine wetlands (5 percent) (USFWS, 2014a). Main threats to palustrine wetlands in Texas include agricultural conversion, urbanization, mining, petroleum extraction, and logging (TPWD, 1997).

[68] Wet prairies are dominated by short grass/sedge vegetation and are inundated (or saturated by surface or groundwater) for no more than a few months per year (USFWS, 2014j).
[69] Bogs are acidic wetlands that form thick organic (peat) deposits up to 50 feet deep or more. They have little groundwater influence and are recharged through precipitation. (APA, 2013)

Estuarine and Marine Wetlands

In Texas, estuarine, or tidal fringe wetlands, can be vegetated (salt marshes) or unvegetated (mud and sand flats), and are found between the open saltwater of the bays or the Gulf of Mexico and the uplands of the coastal plain and barrier islands. These wetlands are found along Texas' shoreline, as shown in Figure 15.1.5-3. Salt marshes are the primary coastal habitat along the Gulf of Mexico, with black mangroves (*Avicennia germinans*) occurring on the upper coast on Galveston Island. Tidal flats are more prevalent in Texas than any other state, with "the Laguna Madre estuary containing 14 percent of the nation's tidal flats" (NOAA, 2010a). Texas' coastal wetlands provide valuable habitat for migratory birds, waterfowl, and "other birds of special concern, such as the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), brown pelican (*Pelecanus occidentalis*), and whooping crane (*Grus americana*)" (TPWD, 1997).

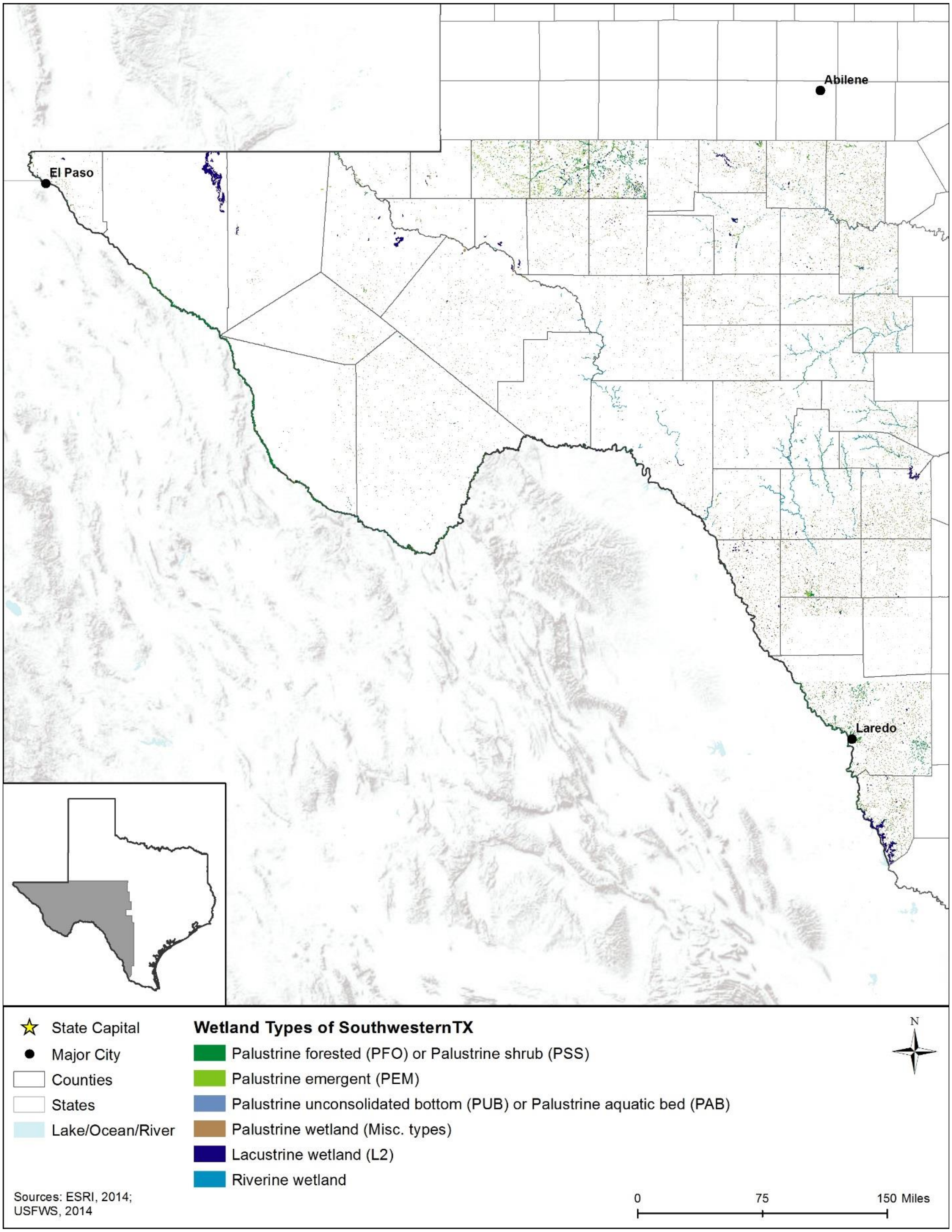


Figure 15.1.5-1: Wetlands by Type, in Southwestern Texas, 2014

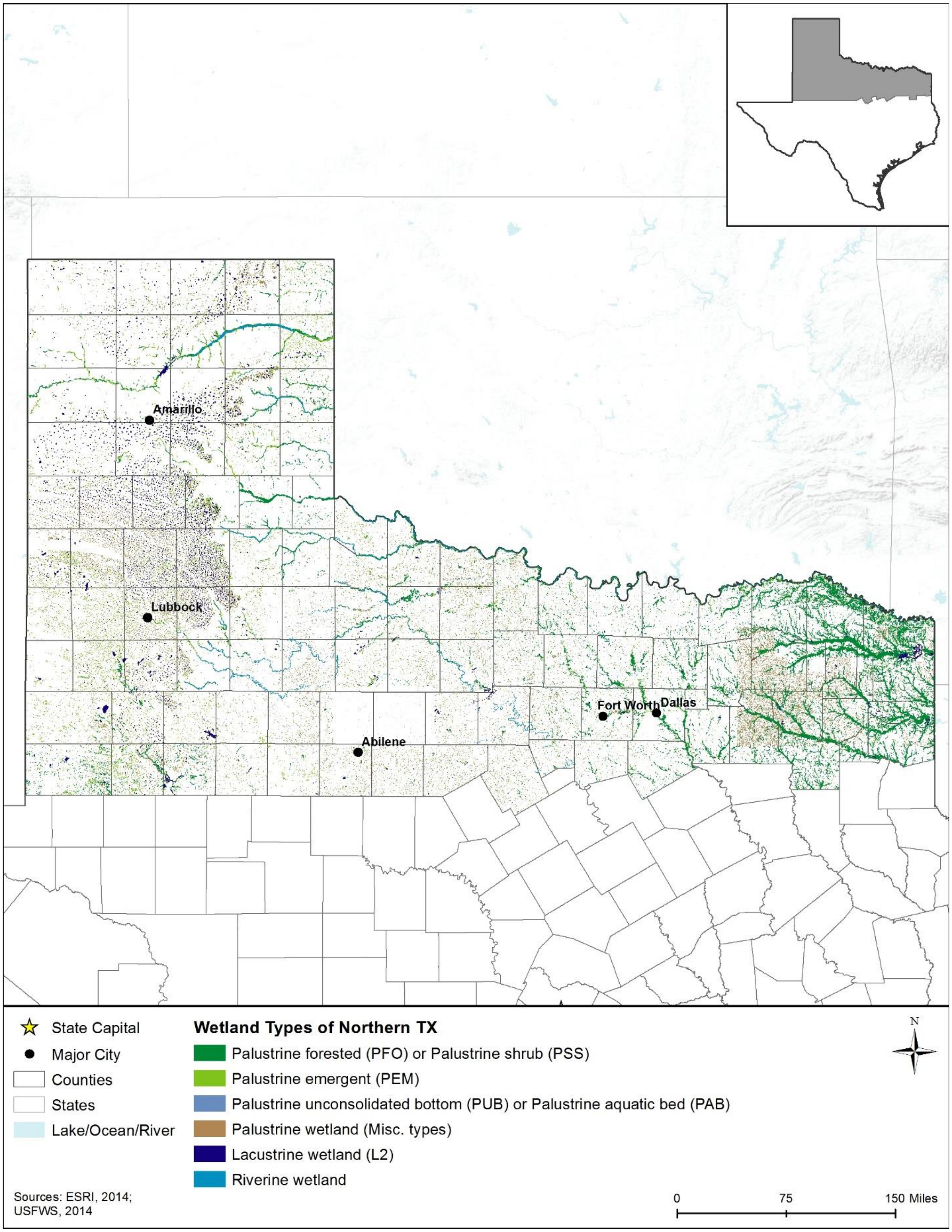


Figure 15.1.5-2: Wetlands by Type, Northern Texas, 2014

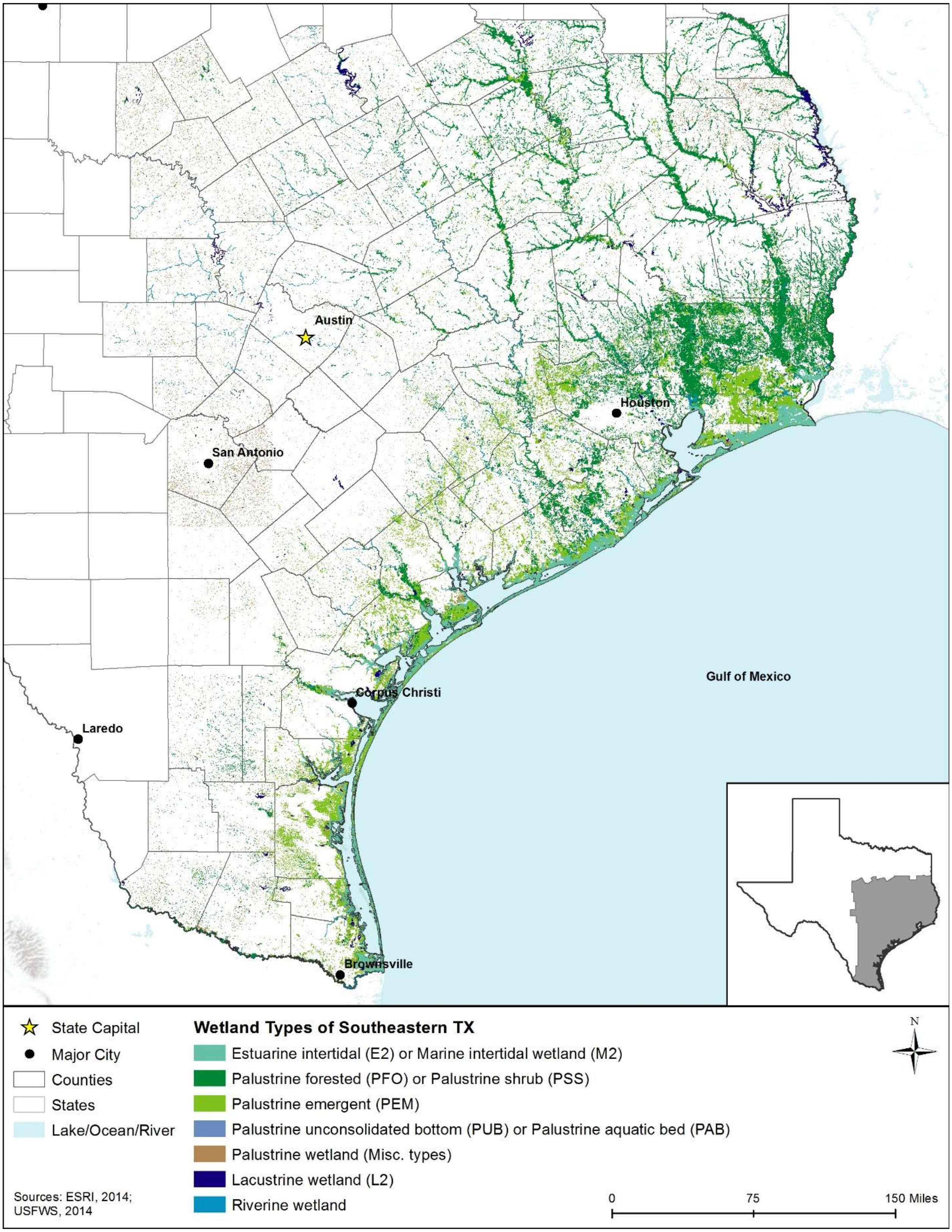


Figure 15.1.5-3: Wetlands by Type, Southeastern Texas, 2014

Coastal development and urban expansion has historically caused great losses to coastal wetlands in Texas. However, tidal wetland losses have been relatively small compared to freshwater wetlands. For example, from 1959 to 1989 Texas lost approximately 8 percent of its estuarine marshland, as compared to approximately 54 percent of freshwater marshes due to "their conversion to urban areas, rangeland or cropland" (TPWD, 1997). Although these ecosystems are now protected by state and local regulations, such as the Texas Coastal and Estuarine Land Conservation Program, Texas Coastal Program, and Seagrass Conservation Plan, habitat loss still occurs due to natural processes and adverse human influences (e.g., subsidence resulting from groundwater or oil and gas withdrawals, and shoreline development). Restoration efforts through the Galveston Bay Estuary Program have prevented large losses of estuarine wetlands and "created, protected, and enhanced 21,150 acres of important coastal habitats" (Galveston Bay Estuary Program, 2015).

15.1.5.4. Wetlands of Special Concern or Value

As part of Texas' CWA Section 401 Water Quality Certification process, TCEQ requires additional review for types of rare or ecologically significant wetlands, which include pitcher plant (*Nepenthes* spp.) bogs, swamps dominated by bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa sylvatica*) tree species, Caddo Lake (designated as a Ramsar Wetland of International Importance),[70] mangrove (*Avicennia* sp. and *Rhizophora* sp.) marshes, and coastal dune swales. These wetlands are also included as part of the regional conditions to the USACE Nationwide permits (CWA Section 404) in Texas. (TCEQ, 2004)

Pitcher Plant Bog

Pitcher plant bogs are predominantly herbaceous wetlands ranging in size from 1 to 10 acres. These bogs commonly found on mid- to low slopes with saturated, nutrient poor soil. Vegetation cover is typically dense and dominated by sedges (*Carex* spp.), grasses, pitcher plants (*Sarracenia* spp.) and orchids. These wetlands are sensitive to changes in the groundwater table and surrounding land management activities (LA CWCS, 2005).

Caddo Lake – Ramsar Wetland Site

Caddo Lake is located on the border of Texas and Louisiana and includes approximately 20,000 acres of both private and public lands. The lake was designated as a "Wetland of International Importance" in 1993 due to the specialized wetland habitat that supports a variety of rare, threatened and endangered plant and animal species, including the peregrine falcon, the alligator snapping turtle (*Macrochelys temminckii*), and the eastern big-eared bat (*Corynorhinus rafinesquii*). The lake also contains a mature bald cypress forest with trees up to 400 years of age and provides essential habitat for migratory birds and a variety of fish species. (Caddo Lake Institute, 2008)

[70] "The Convention on Wetlands of International Importance, known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use (defined as the conservation and sustainable use of wetlands and their resources, for the benefit of humankind) of wetlands and their resources" (USFWS, 2015bd).

Mangrove Marshes

Mangroves are located in the intertidal zone along the Gulf Coast of Texas. These shrubby trees protect the shore during storm surges by reducing wave energy and provide habitat for fish and other aquatic species. Mangrove forests are susceptible to freezing, so their range can fluctuate along the coast depending on cold winters. (NRCS, 2009a)

Coastal Dune Swales

Coastal dune swales are "wetlands and other waters of the United States that are formed as depressions within and among multiple beach ridge barriers, dune complexes, or dune areas adjacent to beaches fronting the tidal waters of the Gulf of Mexico and adjacent to the tidal waters of bays and estuaries. Coastal dune swales are generally comprised either of impermeable muds that act as reservoirs, which collect precipitation or of groundwater nourished wetlands in sandy soils. As such, they generally have a high fresh to brackish water table. Vegetation species characteristically found in coastal dune swales include but are not limited to marshhay cordgrass (*Spartina patens*), gulfdune paspalum (*Paspalum monostachyum*), bulrush (*Scirpus* spp.), seashore paspalum (*Paspalum vaginatum*), common reed (*Phragmites australis*), groundsel bush (*Baccharis halimifolia*), rattlebush (*Sesbania drummondii*), camphor weed (*Pluchea camphorata*), smartweed (*Polygonum* spp.), water hyssop (*Bacopa monnieri*), cattail (*Typha* spp.), umbrella sedge (*Cyperus* spp.), softrush (*Juncus* spp.), sedge (*Carex* spp.), beakrush (*Rhynchospora* spp.), frog-fruit (*Phyla* spp.), duckweed (*Lemna* spp.), buttonweed (*Diodia virginiana*), mist flower (*Eupatorium coelestinum*), creeping spotflower (*Acmella oppositifolia* var. *repens*), pennywort (*Hydrocotyle* spp.), and bushy bluestem (*Andropogon glomeratus*)" (USACE, 2012).

Protected Wetland Areas

As a result of the ongoing significant coastal wetland losses along the Gulf Coast, the USEPA has been working with the Gulf of Mexico Program to "improve water quality in the region, improve coastal community resilience, increase environmental education about the importance of the Gulf of Mexico, and restore critical habitat in the Gulf of Mexico" (USEPA, 2015e). As part of this collaboration, the USEPA and Gulf of Mexico Program developed the Gulf Ecological Management Site (GEMS) Program in order to acquire information about coastal wetland sites and make them accessible to the public through the Internet. Texas has 24 coastal preserve sites included in the GEMS program. (TPWD, 2017)

Texas' coastal zone serves as habitat for numerous fish and wildlife species. In 2006, Mission-Aransas was designated as part of the National Estuarine Research Reserve System (NERRS), which is administered by NOAA. The Mission-Aransas Reserve includes over 185,000 acres, including the Aransas National Wildlife Refuge that protects 24,400 acres of wetlands, and was selected because of the biological diversity of the region's ecosystems. The reserve is comprised of a variety of habitats, such as of tidal flats, seagrass beds, mangroves, and oyster reefs, and "serves as the winter home of the critically endangered whooping crane." As part of the NERR System, "the site is protected for long-term research, water-quality monitoring, education, and coastal stewardship." (NOAA, 2015c)

Other Important Wetland Sites in Texas

- Wetland Nature Centers are open to the public and all are state-protected because of their ecological importance.
- Wildlife Management Areas are designated for outdoor recreation; these public lands include over 714,000 acres, including wetlands (TPWD, 2015f).
- National Natural Landmarks Texas range in size from 2 acres to 16,000 acres, and are owned by a variety of landowners including the USFWS, state parks, and private individuals (NPS, 2015g). Section 15.1.8, Visual Resources, describes Texas' National Natural Landmarks.
- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state. These include Coastal Bend Bays & Estuaries Program, and easements managed by national and local nonprofit natural resource conservation groups such as The Nature Conservancy, Ducks Unlimited and universities. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), the U.S. Natural Resource Conservation Service holds over 110,000 acres in conservation easements in Texas (NCED, 2015).

15.1.6. Biological Resources

15.1.6.1. Definition of the Resource

This section describes the biological resources of Texas. Biological resources include terrestrial[71] vegetation, wildlife, fisheries and aquatic[72] habitats, and threatened[73] and endangered[74] species as well as species of conservation concern. Due to the large size of the state, Texas supports a wide diversity[75] of biological resources, including upland forest, prairies, desert, wetlands, estuaries, and diverse coastal habitats (Griffith, Bryce, Omernik, & Rogers, 2007).

15.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Texas are summarized in detail in Appendix C, Environmental Laws and Regulations, and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 15.1.6-1 summarizes major state laws relevant to Texas' biological resources.

[71] Terrestrial: "Pertaining to land" (USEPA, 2015r).
[72] Aquatic: "Pertaining to water" (USEPA, 2015r).
[73] 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)).
[74] 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)).
[75] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015r).

Table 15.1.6-1: Relevant Texas Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Texas Agricultural Code (TAGC) (Chapter D 71.151 through 71.154.)	Texas Department of Agriculture (TDA)	Requires that TDA publish lists of noxious and invasive plants. Also prohibits the sale, distribution, or importation of any plants on the published list.
Texas Administrative Code (TAC) (4-1-19.T § 19.300)	TDA	Provides list of noxious and invasive plant species.

Sources: (Texas Statutes, 2011), (TSOS, 2017)

15.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,[76] soils, climate,[77] and water of a given geographic area and correlates with distinct areas identified as ecoregions.[78] Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities (National Wildlife Federation, 2015) (USDA, 2015a) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with geographic regions of a state. In Texas, the four main geographic regions include west Texas and Panhandle, central Texas, south Texas and Gulf Coast, and East Texas.

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 Texas at USEPA Level III. (USEPA, 2016a)

As shown in Figure 15.1.6-1, the USEPA divides Texas into 12 Level III ecoregions. The 12 ecoregions support a variety of different plant communities, all predicated on their general location within the state, with five of them occurring in west Texas and Panhandle, three occurring in central Texas, two occurring in south Texas, and two occurring in the east Texas geographic region. Communities range from upland mountainous desert in western Texas, to prairie communities, flooded bottomland forests, and estuaries in the coastal areas in the southern portion of the state (Griffith, Bryce, Omernik, & Rogers, 2007). Table 15.1.6-2 provides a summary of the general abiotic[79] characteristics, vegetative communities, and the typical vegetation found within each of the 12 Texas ecoregions.

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

[77] 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 2015c).

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

[79] 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, 2016d).

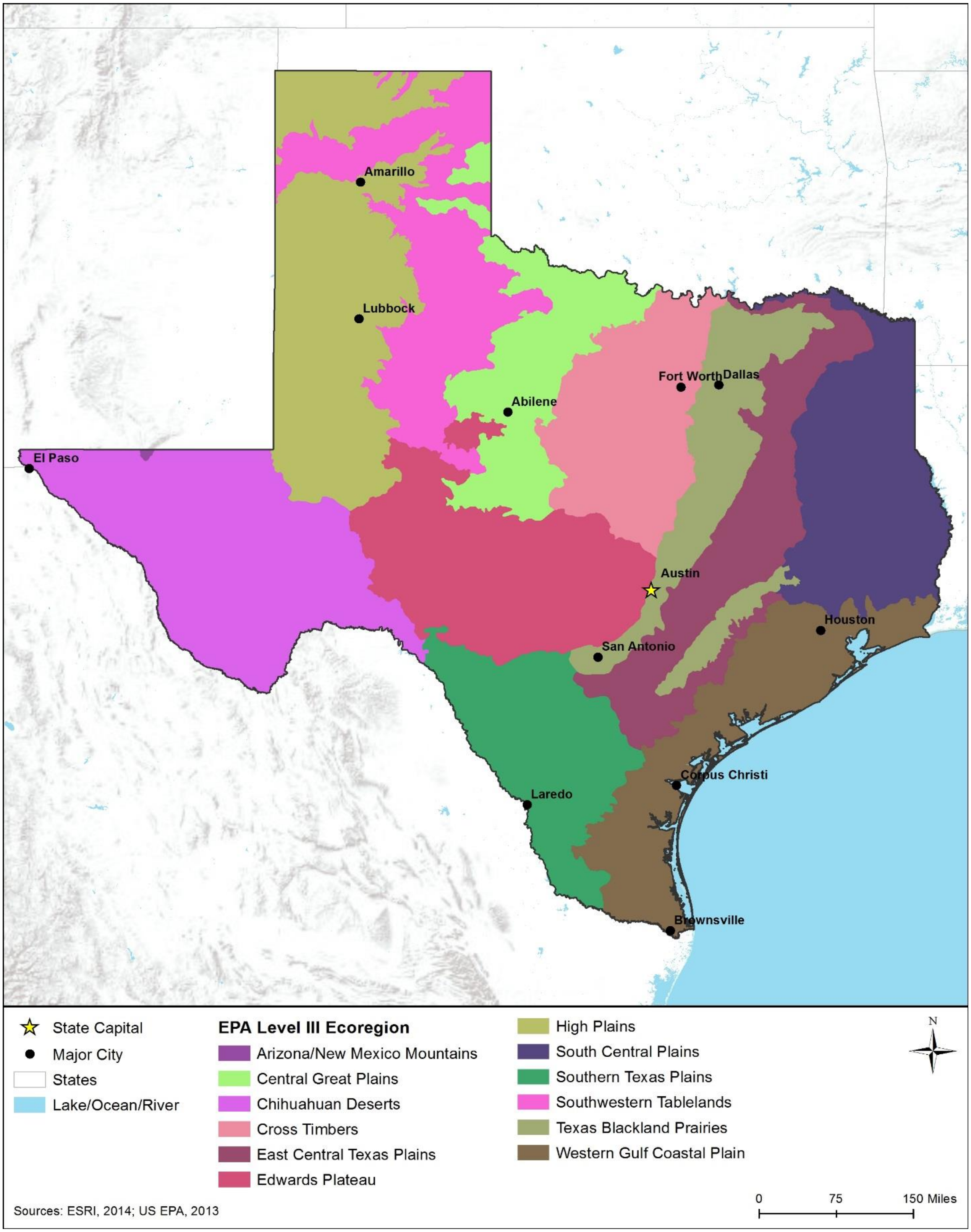

Figure 15.1.6-1: USEPA Level III Ecoregions in Texas

Table 15.1.6-2: USEPA Level III Ecoregions of Texas

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region : West Texas and Panhandle				
23	Arizona/ New Mexico Mountains	This region is comprised of nine separate mountain complexes. Distinct from other mountainous ecoregions in the vicinity by its lower elevation and drier, warmer environment. Because these mountains are surrounded by deserts or grasslands, these are considered biogeographical islands. Annual precipitation typically averages between 12-25 inches, but varies widely. Surface water sources include many ephemeral and some perennial streams and reservoirs.	Chihuahuan desertscrub, Madrean encinal woodland, Madrean pine-oak/conifer-oak forest and woodland, Rocky Mountain montane mixed conifer forest and woodland, Western great plains shortgrass prairie	**Shrubs and Cacti** – Sotol (*Dasylirion* sp.), yucca (*Yucca* spp.), prickly pear (*Opuntia* spp.), ocotillo (*Fouquieria splendens*) , manzanita (*Arctostaphylos* spp.), mountain mahogany (*Cercocarpus montanus*), big sagebrush (*Aretmisia tridentata*) **Trees** – Mexican pinyon (Pinus cembroides), junipers (Juniperus monosperma, J. deppeana, J. scopulorum), oaks (Quercus gambellii, Q. grisea, Q. emoryi, Q. hypoleucoides, Q. rugosa), ponderosa pine (Pinus ponderosa), Arizona sycamore (Platanus wrightii), Douglas-fir (Pseudotsuga menziesii), corkbark fir (Abies lasiocarpa), White fir (A. concolor), blue spruce (Picea pungens), Engelmann spruce (P. engelmannii), aspen (Populus tremuloides), southwestern white pine (P. strobiformis) **Grasses** – Blue grama (*Bouteloua gracilis*), black grama (*Bouteloua eriopoda*), sideoats grama (*Bouteloua curtipendula*), purple threeawn (*Aristida purpurea*), lovegrass (*Eragrostis* spp.), mountain junegrass (*Koeleria macrantha*), galleta (*Pleuraphis* spp.)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
24	Chihuahuan Deserts	The northernmost portion of the southernmost desert in North America and extends 500 miles south into Mexico. Terrain consists of broad basins bordered by isolated, rugged mountains. Climate is arid with hot summers and mild winters, and majority of annual precipitation occurring in summer. Surface water is mostly ephemeral except for major river drainages and widely scattered springs; outside of major river drainages the landscape is largely internally drained.	Chihuahuan semi-desert grassland, Western Great Plains sandhill sagebrush shrubland	**Shrubs and Cacti** – Fourwing saltbush (*Atriplex canescens*), seepweed (*Suaeda* spp.), pickleweed (*Salicornia* sp.), ephedra (*Ephedra* spp.), beargrass (*Nolina* spp.), sotol (*Dasylirion* spp.), lechuguilla (*Agave lechuguilla*), creosotebush (*Larrea tridentata*), tarbush (*Flourensia cernua*), yucca, sand sagebrush (*Artemisia filifolia*), acacia (*Acacia* spp.), ocotillo (*Fouquieria splendens*), lotebush (*Ziziphus obtusifolia*), prickly pear, skunkbush (*Rhus trilobata*) **Trees** – Mesquite (*Prosopis* spp.), juniper, oaks (*Quercus emoryi, Q. grisea*), pinyon pine (*Pinus edulis*), ponderosa pine, cottonwood (*Populus* spp.), willow (*Salix* spp.), velvet ash (*Fraxinus velutina*), tamarisk (*Tamarix* spp.) **Grasses** – Alkali sacaton (*Sporobolus airoides*), grama (*Bouteloua* spp.), sand dropseed (*Sporobolus cryptandrus*), bush muhly (*Muhlenbergia porteri*), threeawn (*Aristida* spp.), sandhill muhly (*Muhlenbergia pungens*), tobosagrass (*Pleuraphis mutica*), little bluestem (*Schizachyrium scoparium*), gypsum grama (*Bouteloua breviseta*)
25	High Plains	Part of a contiguous semi-arid prairie that extends eastward to Kansas and Oklahoma and northward to Wyoming. Characterized by smooth to slightly irregular terrain with intermittent mesas and plateaus. Climate consists of hot summers and cold winters, with half of annual precipitation occurring as late summer thunderstorms. Surface water is limited to few rivers and numerous ephemeral playas. Includes the Llano Estacado - thousands of playa lakes, many of which serve as recharge for the Ogallala Aquifer and are important to the Central Flyway migratory bird corridor.	Western Great Plains shortgrass prairie, Western Great Plains sandhill sagebrush shrubland	**Shrubs and Cacti** –Sand sagebrush, shinnery oak (*Quercus havardii*), yucca, fourwing saltbush, ephedra, tarbush **Trees** – Juniper, mesquite **Grasses** – Blue grama, buffalograss (*Bouteloua dactyloides*), sand dropseed, sideoats grama, switchgrass (*Panicum virgatum*) , western wheatgrass (*Pascopyrum smithii*), little bluestem, alkali sacaton, squirreltail (*Elymus elymoides*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
26	Southwestern Tablelands	Broad plains and tablelands with canyons, mesas, badlands, and dissected river valleys and plains. Climate consists of hot summers and cold winters, with half of annual precipitation occurring as late summer thunderstorms. Average annual precipitation ranges from 12-16 inches.	Western Great Plains shortgrass prairie, Rocky Mountain montane mixed conifer forest and woodland, Pinyon-juniper woodland,	**Shrubs and Cacti** – Skunkbush, fourwing saltbush, yucca, cholla (*Cylindroptunia* spp.), sand sagebrush, broom snakeweed (*Gutierrezia sarothrae*), winterfat (*Krascheninnikovia lanata*) **Trees** – Junipers, honey mesquite (*Prosopis glandulosa*), cottonwood, willow, hackberry (*Celtis* spp.), tamarisk, pinyon pine **Grasses** – Grama (*Bouteloua curtipendula, B. eriopoda, B. gracilis*), western wheatgrass, alkali sacaton, galleta, sand dropseed, western wheatgrass, threeawn, ring muhly (*Muhlenberegia torreyi*), little bluestem
27	Central Great Plains	Once a transitional region between the shortgrass prairies to the west and the tallgrass prairies to the east, this ecoregion is now primarily agriculture. In the south, mixed-prairie exists with scattered shrubs.	Short and midgrass prairie	**Deciduous Trees –** Pecan (*Carya illinoensis*), American elm (*Ulmus americana*), black willow (*Salix nigra*), honey mesquite, little walnut (*Juglans microcarpa*) **Shrubs and Cacti –** lotebush, prickly pear, wolfberry, yucca, ephedra, tree cholla (*Opuntia imbricata*) **Grasses –** little bluestem, sideoats grama, buffalograss, Indiangrass (*Sorghastrum nutans*)
Geographic Region : Central Texas (including North Central Texas, South Central Texas, and Texas Hill Country				
29	Cross Timbers	A transitional areas between wheat cropland to the west and montane areas to the east containing a variety of landscapes, including plains, forest, woodlands, and savanna. Oil production and ranching are common in the region.	Oak savanna, tall to midgrass prairie, ridgetop woodland	**Trees –** post oak (*Quercus stellate*), blackjack oak (*Quercus marilandica*), eastern redcedar (*Juniperus virginiana*), mesquite, netleaf hackberry (*Celtis reticulata*), ashe juniper (*Juniperus ashei*), plateau live oak (*Quercus fusiformis*), big tooth maple (*Acer grandidentatum*), bur oak (*Quercus macrocarpa*) **Shrubs and Vines –** persimmon (*Diospyros virginiana*), sassafras (*Sassafras albidum*), Virginia creeper (*Parthenocissus quinquefolia*) **Grasses –** Indiangrass, little bluestem, big bluestem, tall dropseed (*Sporobolus asper*), switchgrass, silver bluestem (*Bothriochloa laguroides* ssp. *torreyana*), Texas cupgrass (*Eriochloa sericea*), sideoats grama, purple threeawn (*Aristida purpurea*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
30	Edwards Plateau	Primarily composed of a large limestone plateau with varying topography and perennial streams present throughout the area. Ranching and game hunting are common in the region.	Plateau woodland, midgrass prairie, upland woodland, scrub-shrub	**Trees –** Texas oak (*Quercus buckleyi*), Texas ash (*Fraxinus texensis*), ashe juniper (*Juniperus ashei*), plateau live oak, blackjack oak, cedar elm (*Ulmus crassifolia*), black hickory (*Carya texana*), slippery elm (*Ulmus rubra*), box elder (*Acer negundo*), bigtooth maple (*Acer grandidentatum*), Carolina basswood (*Tilia caroliniana*) **Shrubs –** Juniper, Texas persimmon (*Diospyros texana*), agarito (*Mahonia trifoliolata*), catclaw mimosa (*Mimosa aculeaticarpa*), soaptree yucca (*Yucca elata*), lotebush **Herbaceous –** blue grama, black grama, buffalograss, silver bluestem, sand lovegrass (*Eragrostis trichodes*), Texas bluebonnet (*Lupinus texensis*), Indian blankets (*Gaillardia aestivalus*), Nuttall's stonecrop (*Sedum nuttallianum*), maidenhair fern (*Adiantium capillus-veneris*)
32	Texas Blackland Prairies	A tallgrass prairie region with fine-textured, clay soils. This region has widespread cropland and grazing and is areas are being converted to developed landscapes.	Riparian and floodplain woodlands, tallgrass prairie	**Trees** – bur oak, sugar hackberry, pecan, cottonwood, Shumard oak (*Quercus shumardii*), eastern red cedar, post oak, blackjack oak **Herbaceous** – little bluestem, big bluestem, Indiangrass, tall dropseed (*Sporobolus asper*), switchgrass, coneflowers (*Rudbeckia* spp.), prairie bluet

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region : South Texas and Gulf Coast				
31	Southern Texas Plains	Previously grassland and savanna, this area is now covered in thorny, shrubby vegetation due to grazing and fire suppression. Oil and gas activity are common in the region.	Riparian and floodplain woodlands, scrub-shrub, mesquite-acacia savanna	**Trees –** honey mesquite, plateau live oak, sycamore (*Plantanus americanus*), sugar hackberry (*Celtis laevigata*), cottonwood, pecan **Shrubs and Cacti –** guajillo (*Acacia berlandeieri*) blackbrush (*Acacia ridigula*), kidneywood (*Eysenhardtia texana*), tarbush, yucca, prickly pear, lotebush **Herbaceous –** little bluestem, Arizona cottontop (*Digitaria California*), sideoats grama, green sprangletop (*Leptochloa dubia*), plains bristlegrass (*Setaria macrostachya*), common reed (*Phragmites australis*), bulrushes (*Schoenoplectus* spp.), giant reed (*Arundo donax*)
34	Western Gulf Coastal Plain	Flat topography and grasslands characterize this area, although savannas and forests are possible inland from the coast. Agriculture, urban, and industrial developments are common, including oil and gas production.	Coastal prairie, coastal marsh, riparian and floodplain forests and valleys, beach dunes	**Trees –** post oak, loblolly pine (*Pinus taeda*), pecan, cedar elm, southern live oak (*Quercus virginiana*), water oak (*Quercus nigra*), black hickory (*Carya texana*), bald cypress (*Taxodium distichum*) **Shrubs –** blackbrush, granjeno (*Celtis pallida*), huisache (*Acacia smallii*) **Herbaceous –** little bluestem, Indiangrass, brownseed paspalum (*Paspalum plicatulum*) gulf muhly (*Muhlenbergia capillaris*), switchgrass, tall dropseed, plains bristlegrass, silver bluestem, sandbur (*Cenchrus* spp.), paspalum (*Paspalum* spp.), seacoast bluestem (*Schizachyrium scoparium* var. *littorale*), spikerush (*Eleocharis* spp.), bulrush, saltgrass (*Distichalis spicata*), cordgrass (*Spartina* spp.), cattail (*Typha* spp.), phlox (*Phlox* spp.), sea-oats (*Uniola paniculata*)

Ecoregion Number	Ecoregion Name	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region : East Texas				
33	East Central Texas Plains	Mixed landscapes of post oak savanna and prairies, with clay to sandy soils. Underlying clay pan restricts water movement in some areas. Grazing is common in this region.	Oak savanna, tallgrass prairie, mixed pine forest, riparian and floodplain forests	**Trees –** post oak, blackjack oak, eastern redcedar, black hickory, loblolly pine, water oak, green ash (*Fraxinus caroliniana*), pecan, sugar hackberry **Shrubs and Vines –** farkleberry (*Vaccinium arboreum*), winged elm (*Ulmus alata*), yaupon (*Ilex vomitoria*), poison ivy (*Toxicodendron* spp.), grape (*Vitis* spp.), dewberry (*Rubus* spp.) **Herbaceous –** little bluestem, curly threeawn (*Aristida desmantha*), purpletop, Indiangrass, switchgrass, Virginia wildrye (*Elymus virginicus*)
35	South Central Plains	Hardwood and pine forests previously dominated the loblolly and shortleaf pine plantation landscape currently present. Timber and oil and gas production are common in the area.	Pine plantation, mixed forest, riparian, floodplain, and bottomland forests, wet savanna,	**Trees –** loblolly pine, shortleaf pine (*Pinus echninata*), post oak, white oak (*Quercus alba*), hickory (*Carya* spp.), sweetgum (*Liquidamber styraciflua*), bluejack oak (*Quercus incana*), red maple (*Acer rubrum*), bald cypress, water elm, American beech (*Fagus grandifolia*), longleaf pine (*Pinus palustris*) **Shrubs –** American beautyberry (*Callicarpa americana*), sumac (*Rhus* spp.), hawthorn (*Crataegus* spp.), willow **Herbaceous –** Indiangrass, pinehill bluestem (*Schizachyrium scoparium* var. *divergens*), panicums (*Panicum* spp.), sweetbay (*Magnolia virginiana*), wax-myrtle (*Morella* spp.)

Sources: (Griffith, Bryce, Omernik, & Rogers, 2007) (CEC, 2011)

Communities of Concern

Texas 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 that could result from implementation of an action. (TPWD, 2016a)

TPWD and NatureServe have developed a statewide inventory that includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the TPWD ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its rarity within Texas. Communities ranked as an S1 by the TPWD and NatureServe 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. (TPWD, 2016a)

Twenty-nine vegetative communities are ranked as S1 communities[80] in Texas; these communities represent the rarest terrestrial habitat in the state. These communities occur in all four geographic regions within the state (TPWD, 2016a). Texas Appendix A, Table A-1, provides a description of the communities of conservation concern in Texas along with their 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[81] plants. Noxious weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (USGPO, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. § 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b), of which 25 are known to occur in Texas (Texas Invasive Plant and Pest Council, 2011).

[80] S1: "Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province" (TPWD, 2016a).

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

- **Aquatic** – anchored water hyacinth (*Eichornia azurea),* salvinia (*Salvinia* spp.), Eurasian watermilfoil (*Myriophyllum spicatum*), giant duckweed (*Spirodela oligorrhiza*), hydrilla (*Hydrilla verticillata*), purple loosestrife (*Lythrum salicaria*), water lettuce (*Pistia stratiotes*), and water spinach (*Ipomoea aquatica*).
- **Shrubs and trees** –Brazilian peppertree (*Schinus terebinthifolius*), Chinese tallow tree (*Triadica sebifera*), melaleuca (*Melaleuca leucadendron*), salt cedar (*Tamarix* spp.), and tropical soda apple (*Solanum viarum*).
- **Terrestrial Forbs and Grasses** – alligator weed (*Alternanthera philoxeroides*), balloon vine (*Cardiospermum halicacabum)*, camelthorn (*Alhagi maurorum*), giant reed (*Arundo donax*), hedge bindweed (*Calystegia sepium*), broomrape (*Orobanche ramosa*), itchgrass (*Rottboellia cochinchinensis*), Japanese dodder (*Cuscuta japonica*), kudzu (*Pueraria montana* var. *lobata*), lagarosiphon (*Lagarosiphon major*), serrated tussock (*Nassella trichotoma*), and torpedo grass (*Panicum repends*).

15.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Texas, divided among mammals,[82] birds,[83] reptiles and amphibians,[84] and invertebrates.[85] Terrestrial wildlife consists of those species, and their habitats, that live predominantly on land. Terrestrial wildlife includes common big game species, small game animals, furbearers, nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Texas. 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. Texas is home to approximately 141 mammal species, 228 reptile and amphibian species, and 641 resident and migratory bird species (Texas Ornithological Society, 2015) (Texas Tech University, 1997).

Mammals

Common and widespread mammalian species in Texas include the black-tailed prairie dog (*Cynomys ludovicianus*), raccoon (*Procyon lotor*), nine-banded armadillo (*Dasypus* novemcinctus), striped skunk (*Mephitis mephitis*), and Virginia opossum (*Didelphis virginiana*). Mammals such as the swift fox (*Vulpes velox*), river otter (*Lutra canadensis*), and ocelot (*Leopardus pardalis*) are uncommon or rare in Texas due to limited habitat or secretive behavior (TPWD, 2015g). A number of threatened and endangered mammals are located in Texas. Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

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[82] 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, 2015r).
[83] Birds: “Warm-blooded vertebrates possessing feathers and belonging to the class Aves” (USEPA, 2015r).
[84] 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, 2015r).
[85] Invertebrates: “Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc.” (USEPA, 2015r).

In Texas, white-tailed deer (*Odocoileus virginianus*), mule deer (*O. hemionus*), pronghorn antelope (*Antilocapra americana*), desert bighorn sheep (*Ovis canadensis nelsoni*), and collared peccary (*Pecari tajacu*) are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game birds. The following 12 species of furbearers may be legally hunted or trapped in the Texas: badger (*Taxidea taxus*), raccoon (*Procyon lotor*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), ringtail (*Bassariscus astutus*), skunk (*Mephitis* spp.), beaver (*Castor canadensis*), opossum (*Didelphis virginiana*), nutria (*Myocastor coypus*), and river otter (*Lontra canadensis*) (TPWD, 2015h).

Texas has identified 75 mammals as Species of Greatest Conservation Need (SGCN). Twenty-one of these species are bats. The SGCN list consists of at-risk species that are rare or declining, and can receive funding from State Wildlife Grants for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation, they are not currently under legal protection. The SGCN list is updated periodically and is used by the state of Texas to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP) (TPWD, 2011).

Birds

The number of native bird species documented in Texas varies according to the timing of the data collection effort, changes in bird taxonomy,[86] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., prairies, forests, large rivers and lakes, plains, etc.) found in Texas support a large variety of bird species. Approximately 641 species of resident and migratory birds have been documented in Texas, including the northern saw-whet owl (*Aegolius acadicus*), short tailed hawk (*Buteo brachyurus*), and black-whiskered vireo (*Vireo altiloquus*) (Texas Ornithological Society, 2015). Among the 641 extant[87] species in Texas, 110 SGCN have been identified (TPWD, 2011).

Texas is located entirely within the Central Flyway, which spans from the Gulf of Mexico to the Canadian boreal forest. Large numbers of migratory birds utilize this flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall (NAS, 2015a). "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, or 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 Part 10.13 (USFWS, 2013a).

[86] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015r).
[87] Extant: "A species that is currently in existence (the opposite of extinct)" (USEPA, 2015r).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in the entire state during the winter season (eBird, 2015a). Golden eagles are generally found in a variety of habitat types throughout their range, but they generally nest in mountains and cliffs. Golden eagles are found in the northwestern parts of the state during the winter season (eBird, 2015b) (Texas A&M University, 2007).

A number of Important Bird Areas (IBAs) have also been identified in Texas, as can be seen in Figure 15.1.6-2. The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds, and to conserve these areas. These IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, and birders. These IBAs link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or support local populations of birds (NAS, 2015e).

According to the National Audubon Society (NAS), a total of 25 IBAs have been identified in Texas, including breeding,[88] migratory stop-over, feeding, and over-wintering areas, encompassing a variety of habitats such as native grasslands, forests, large rivers, and wetland/riparian[89] areas (NAS, 2015a). These IBAs, which cover approximately 655,000 acres, are widely distributed throughout the state, although the largest concentration of IBAs are located in southeast Texas near the Gulf Coast. Many of these IBAs are existing National Wildlife Refuges within the state that contain bottomland hardwood forests, floodplain, and island or shoreline habitat. These habitats are an important migration stop and breeding ground for many waterfowl species. Fort Hood and Columbia bottoms are the two largest IBAs in Texas coving approximately 217,000 and 177,000 acres, respectively (NAS, 2015b).

A number of threatened and endangered birds are located in Texas. Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

[88] Breeding range: "The area utilized by an organism during the reproductive phase of its life cycle and during the time that young are reared" (USEPA, 2015r).
[89] Riparian: "Referring to the areas adjacent to rivers and streams with a differing density, diversity, and productivity of plant and animal species relative to nearby uplands" (USEPA, 2015r).

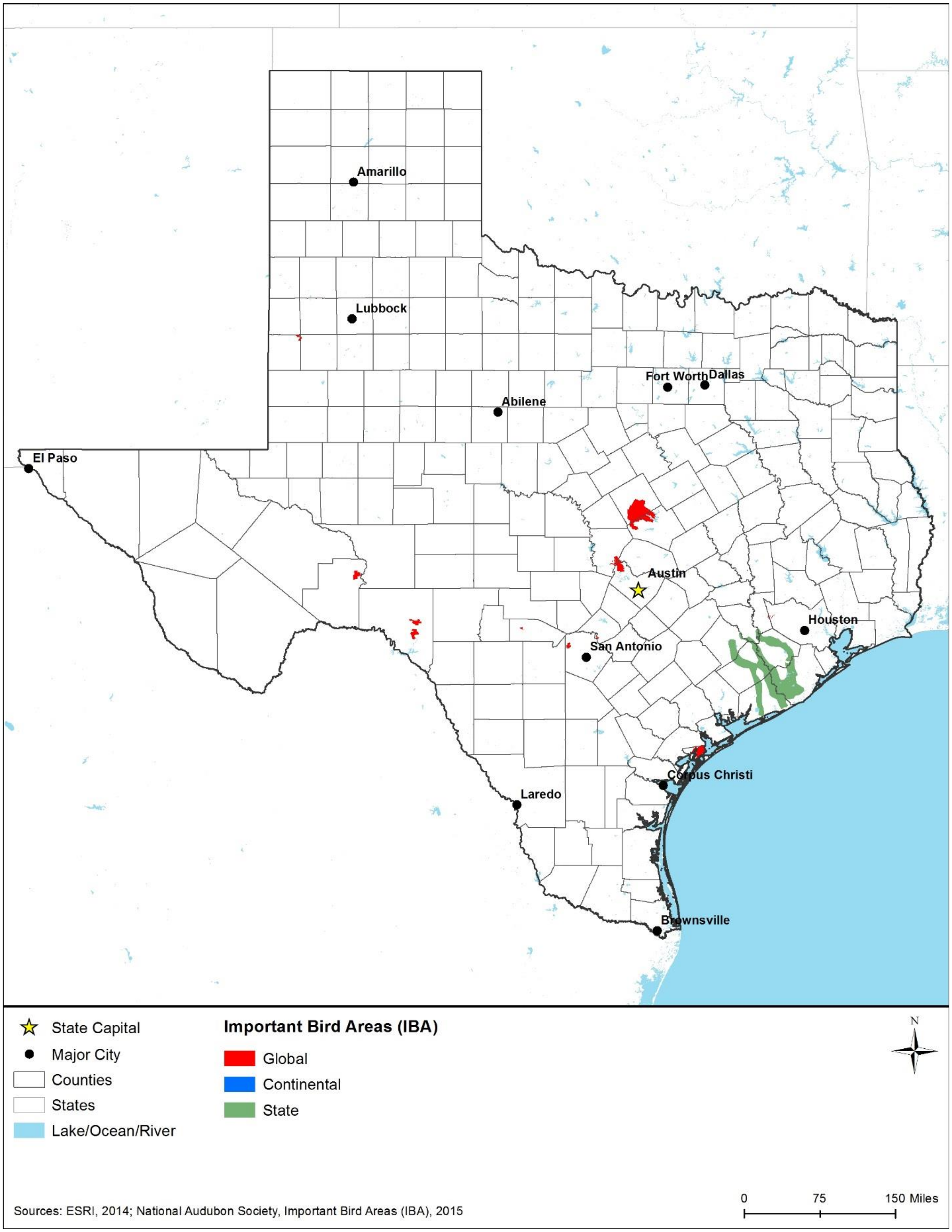


Figure 15.1.6-2: Important Bird Areas (IBA) of Texas

Reptiles and Amphibians

Approximately 228 native reptile and amphibian species occur in the state of Texas, including 26 salamanders, 45 frogs and toads, 29 turtles, 51 lizards, and 77 snakes. Many of these species are widespread throughout the state and occur in a wide variety of habitats, including upland hardwoods, prairie, and desert habitats. Of the 228 native reptile and amphibian species, 67 SGCN have been identified. Seventeen of these SGCN species are snakes (TPWD, 2011).

In the state of Texas, the American alligator (*Alligator mississippiensis*) is classified as a game animal, and hunting is allowed in accordance with TPWD state hunting regulations (TPWD, 2015i). Collection and take of the remainder of the state's reptile and amphibian species is regulated under Texas Administrative Code, § 65.331.

A number of threatened and endangered reptiles and amphibians are located in Texas. Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Invertebrates

Texas is home to an unknown number of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes (TPWD, 2011). These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. In the US, one third of all agricultural output depends on pollinators.[90] 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, 2009b). Of the invertebrates that occur in Texas, 448 have been listed as SGCN (TPWD, 2011).

A few terrestrial invertebrate species are threatened and endangered in Texas. Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Invasive Wildlife Species

Texas has identified several terrestrial non-native (invasive) wildlife species that are "unwanted" in the state. Nutria, feral hogs, fire ants, and European starlings cause damage to the natural environment and other species (TPWD, 2016b). Texas requires permits "for any individual to possess, sell, import, export, transport or propagate listed species for zoological or research purposes; for aquaculture (allowed only for Blue, Nile, or Mozambique tilapia, Triploid Grass Carp, or Pacific White Shrimp); or for aquatic weed control (for example, Triploid Grass Carp in private ponds)" (TPWD, 2016c). Section 15.2.1.5, Fisheries and Aquatic Habitat summaries the aquatic invasive species program. Section 15.2.1.3, Terrestrial Vegetation, summarizes the noxious weed program.

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

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.

15.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Texas, including freshwater fish, saltwater fish, invertebrates, marine mammals, and sea turtles. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Texas landscape with regard to aquatic wildlife is the coastal habitat of the Gulf of Mexico, which provides habitat for a variety of aquatic wildlife. Essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Texas (NOAA, 2010b) (NOAA, 2015d). Critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Texas and is discussed in Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

Texas is home to 247 species of freshwater fish, ranging in size from small darters and minnows to larger species, such as those in the gar family. Sixty-three of these species are listed as SGCN. The state's complex aquatic habitat allows for a wide diversity of freshwater fish divided into numerous families. A brief description of those families that contain common species, notable sport fish species, or species of concern, are listed below (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

Fourteen species of freshwater catfish occur in the state of Texas, including the brown bullhead (*Ameiurus nebulosus*), black bullhead (*Ameriurus melas*), and the yellow bullhead (*Ameiurus natalis*). In addition, two species of blind catfish are listed as SGCN in Texas. All are smaller members of the catfish family that rarely reach an adequate size to be targeted by fishermen. Larger members of the catfish family include the channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), and the blue catfish (*Ictalurus furcatus*). These species are widespread throughout the state and can be found in almost any habitat (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

There are 78 species from the minnow/carp family in Texas. Several of these species, including 19 species of shiner and 4 species of chub, are listed as SGCN. Common and widely distributed minnow species in Texas include the common carp (*Cyprinus carpio*), creek chub (*Semotilus atromaculatus*), and common shiner (*Notropis cornutus*). Minnows are not typically a popular sportfish, but are a commercially important fish and an important prey source for larger fish and other wildlife (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

Texas waters are home to 32 species of perches, with 26 of these species being darters. Six species of darter are listed as SGCN. Darters are small members of the perch family that are not considered to be sport fish sought after by fishermen. Walleye (*Etheostoma fusiforme*) and sauger (*Sander canadensis*) are larger members of the perch family and are important sport fish in Texas. These species are common in the large rivers, lakes, and reservoirs throughout the state (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

Two species of pike occur in Texas waters: the redfin pickerel (*Exox americanus*) and chain pickerel (*Esox niger*). Chain pickerel and redfin pickerel are smaller member of the pike family and are the only native pike species to the state. They are found in the backwaters and bays of lakes and reservoirs with dense weed growth and submerged logs (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

The sunfish family includes 20 species, many of which are common throughout the state and are highly popular with sport fishermen. The most commonly encountered species are the bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), largemouth bass (*Micropterus salmoides*), and smallmouth bass (*Micropterus dolomieu*). These sunfish species live in a wide variety of habitats, including rocky, cool lakes streams and reservoirs (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

The American eel (*Anguilla rostrata*), is the only member of the eel family in the state Texas, and is listed as a SGCN. American eels were once found throughout much of the state, but their current distribution is limited by the construction of dams. In Texas, American eels are found primarily in deep pools of large rivers and streams. American eels spend the majority of their life in freshwater but they migrate to the Atlantic Ocean to spawn (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

The gar family contains four species in Texas: the alligator gar (*Atractosteus spatula*), lognose gar (*Lepisosteus osseus*), spotted gar (*Lepisosteus oculatus*), and shortnose gar (*Lepisosteus platostomus*). The alligator gar is listed as a SGCN in Texas. Historically, alligator gar were an important sport and commercial fish species. Populations have declined rapidly in the last 50 years, but alligator gar are still avidly sought after by sport fishermen due their size and behavior (Hendrickson & Cohen, 2015) (Klym & Garret, 2002) (TPWD, 2011).

Shellfish and Other Invertebrates

Texas is home to an unknown number of mollusk and crustacean species, including a multitude of freshwater mussels and crayfish. Forty-eight species of freshwater mussels and 22 species of crayfish are listed as SGCN. River diversions and impoundments are a primary threat to Texas' native mussel species. Aside from a multitude of freshwater invertebrates whose adult forms are terrestrial insects (e.g., flies, beetles, etc.), other well-known Texas freshwater invertebrates include a variety of fairy shrimp, amphipods, and pillbug species. (TPWD, 2011)

Invasive Aquatic Species

Texas has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and propagation of select aquatic invasive species without a permit. TPW maintains a list of prohibited exotic species. According to TAC §57.111- §57.137, there are 19 aquatic plant, 6 shellfish, and 46 fish species and/or families that are prohibited in the state (TPWD, 2015j).

Saltwater Fish

Texas has extremely diverse coastal habitats including seagrasses, oyster reefs, salt marshes, barrier islands, coastal wetlands, muddy estuarine bottoms, and reefs. These habitats support a wide array of saltwater fish species creating both commercial and recreational fisheries. Sixty-eight saltwater fish species have been designated SGCN in Texas.

Many saltwater fish species are known for their recreational and commercial fishing value. Commonly caught species in the marine waters off the coast of Texas include cobia (ling or lemonfish), black drum (*Hyperoglyphe bythites*), red drum (*Sciaenops ocellatus*), southern flounder (*Paralichthys lethostigma*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), striped mullet (*Mugil cephalus*), spotted seatrout (*Cynoscion nebulosus*), blue marlin (*Makaira nigricans*), sailfish (*Istiophorus*), swordfish (*Xiphias gladius*), yellowfin tuna (*Thunnus albacares*), gag grouper (*Mycteroperca microlepis*), several types of snapper, gray triggerfish (*Balistes capriscus*), tilefish (*Lopholatilus chamaeleonticeps*), amberjack (*Seriola dumerili*), snook (*Centropomus undecimalis*), and tripletail (*Lobotes surinamensis*). Crabbing, oyster-harvesting, and shrimping are also activities that occur in saltwaters of Texas (Hendrickson & Cohen, 2015) (TPWD, 2011) (TPWD, 2015k).

Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies protected saltwater fish species.

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[91] and website[92] 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.[93] (NOAA, 2015d) (NOAA, 2015e)

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, 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

[91] http://www.habitat.noaa.gov/protection/efh/efhmapper/index.html.
[92] http://www.greateratlantic.fisheries.noaa.gov/hcd/list.htm.
[93] 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).

subject to more stringent EFH conservation recommendations (NOAA, 2010b). Table 15.1.6-3 presents a summary of HAPC along or near the Texas coast.

Table 15.1.6-3: Habitat Areas of Particular Concern for Texas

Species	Description of EFH - HAPC
Specific HAPCs in the Gulf of Mexico	All of the EFH areas are offshore, and none are close to Texas waters. EFH includes offshore areas at Florida Middle Grounds, Madison-Swanson Marine Reserve, Tortugas North and South Ecological Reserves, Pulley Ridge, and the individual reefs and banks of the Northwestern Gulf of Mexico: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil, 29 Fathom Bank, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderice Bank, and Jakkula Bank.

Sources: (NOAA, 2005) (NOAA, 2009a) (NOAA, 2015d)

Marine Aquatic Invertebrates

Texas is home to approximately 70 species of marine mollusks, 41 species of crabs, and 21 species of shrimp. None of these species are currently listed as SGCN (TPWD, 2015k) (TPWD, 2015l).

Marine Mammals

Texas coastal waters are home to 26 species of marine mammals. Sixteen of these are designated as SGCN, including manatees, dolphins, and whales. In addition, Texas recognizes the protection of the West Indian manatee *(Trichechus manatus)*. Marine mammals are more commonly abundant in offshore waters (Texas Tech University, 1997) (TPWD, 2011). Detailed information on the marine mammal species listed under the ESA is presented in Section 15.1.6.6., Threatened and Endangered Species and Species of Conservation Concern.

Sea Turtles

Texas waters are home to five species of sea turtles and all are listed as SGCN, except for the green sea turtle (*Chelonia mydas*). Furthermore, all marine sea turtles present in Texas are also federally listed. The endangered Kemp's ridley sea turtle (*Lepidochelys kempii*), endangered hawksbill sea turtle (*Eretmochelys imbricata*), endangered leatherback sea turtle (*Dermochelys coriacea*), threatened green sea turtle, and threatened loggerhead sea turtle (*Caretta caretta*) make up the sea turtles found in Texas waters (NPS, 2016a) (TPWD, 2011). For more information on these protected sea turtles, refer to Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

15.1.6.6. Threatened and Endangered Species

This section describes potential impacts to threatened and endangered species in Texas's inland and offshore environment associated with the deployment and operation of the Proposed Action and Alternatives. The USFWS is responsible for administering the ESA (16 U.S.C. § 1531 et seq.) in the state of Texas. The USFWS has identified 79 federally endangered and 20 federally threatened species known to occur in Texas (USFWS, 2016a) (NOAA, 2016a). Of these 99 federally listed species, 36 of them have designated critical habitat[94] (USFWS, 2015c), as can be seen in Table 15.1.6-3 and Figure 15.1.6-3. Ten candidate species[95] are identified by USFWS as occurring within the state (USFWS, 2016b). Candidate species are not afforded statutory protection under the ESA. However, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014b). The 99 federally listed species include 4 mammals, 4 reptiles, 14 birds, 10 fishes, 8 amphibians, 27 invertebrates, and 30 plants (USFWS, 2016a), and are discussed in detail under the following sections.

Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency might be required.

[94] 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)).

[95] 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, 2014b).

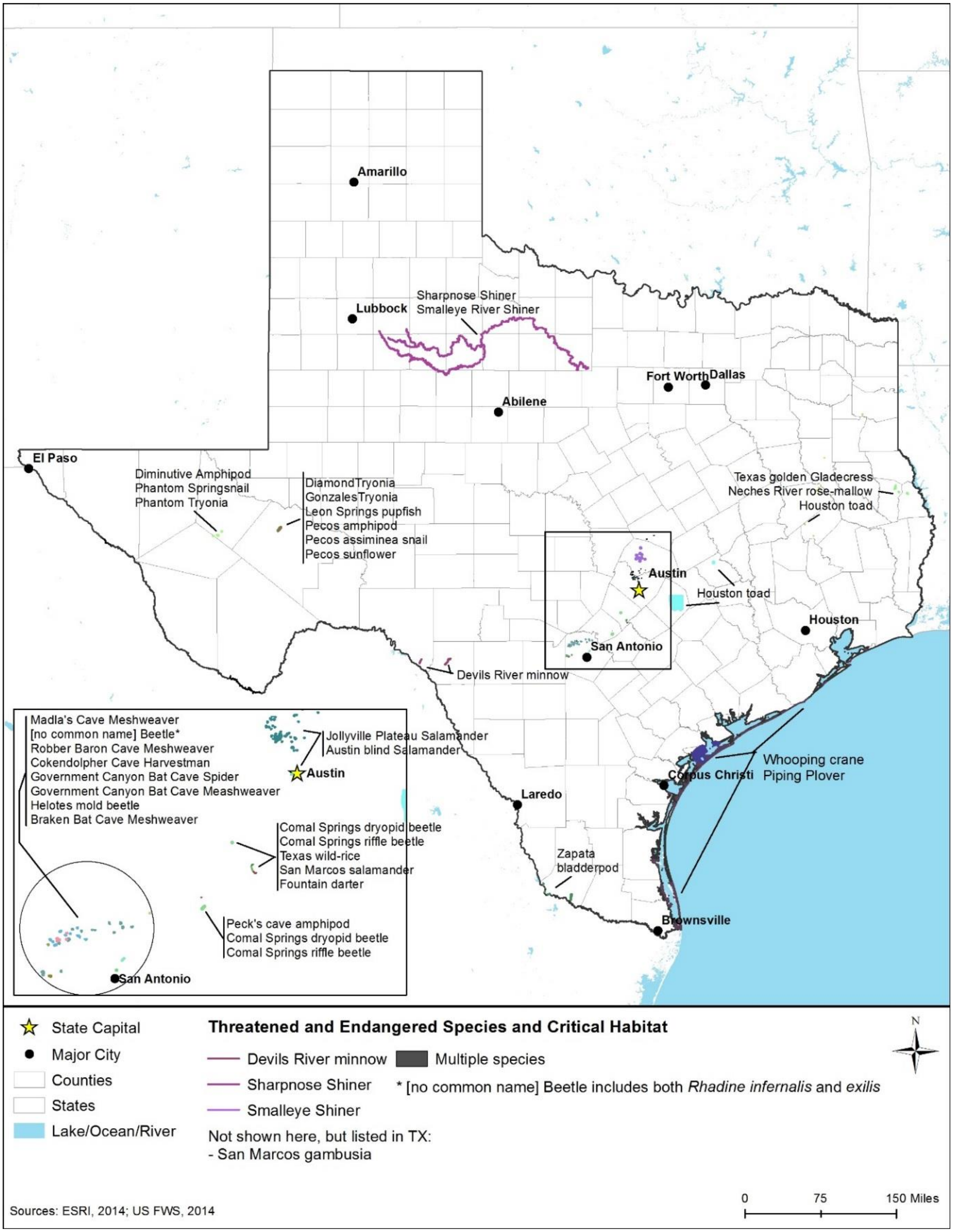


Figure 15.1.6-3: ESA Designated Critical Habitat in Texas

Mammals

Three endangered mammals and one threatened mammal are federally listed for Texas as summarized in Table 15.1.6-4 (USFWS, 2016a). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-4: Federally Listed Mammal Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Gulf Coast Jaguarundi	*Herpailurus yagouaroundi cacomitli*	Endangered	No	Dense, thorny shrublands and woodlands and adjacent pastures or grasslands with bunchgrasses.
Mexican Long-nosed Bat	*Leptonycteris nivalis*	Endangered	No	Upper desert scrub and pine-oak woodlands with cacti and agave present. Found in Grant and Hidalgo Counties, southwestern New Mexico.
Ocelot	*Leopardus pardalis*	Endangered	No	Dense canopy forests, savanna, shrublands, and marshlands with contiguous tracts of land.
West Indian Manatee	*Trichechus manatus*	Threatened	No	Tropical and subtropical coastal and river waters. Found in 18 parishes along the Gulf of Mexico and southern Louisiana.

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

Gulf Coast Jaguarundi. The Gulf Coast jaguarondi (*Herpailurus yagouaroundi cacomitli*) is a small cat, with a long neck, short legs, and a long tail with either blackish to brownish gray or reddish yellow to chestnut colored fur. Tails range from 11 to 24 in. in length and individuals typically weigh 8.4 to 19.8 lbs. The jaguarondi head is small and flattened, which is a distinguishing feature. However, this species can be easily confused with a large feral black house cat (*Felis catus*). The Gulf Coast jaguarondi was listed as endangered in 1976 (41 FR 24062 24067, June 14, 1976) with no critical habitat (USFWS, 2016c). Regionally, the species historically occurred from the Lower Rio Grande Valley in southern Texas to the eastern part of Mexico, within Coahuila, Nuevo Leon, Tamaulipas, San Luis Potosi, and Veracrus. In Texas, the Gulf Coast jaguarondi is presumed to be extirpated and has not been seen within the U.S. since April 1986. (USFWS, 2013b)

Gulf Coast jaguarondi prefer dense shrubby woodlands and grasslands with bunchgrasses. In southern Texas, the species was previously recorded in dense, thorny shrublands with species such as brasil (*Condalia hookeri*), desert yaupon (*Schaefferia cuneifolia*), wolfberry (*Lycium berlandieri*), lotebush (*Ziziphus obtusifolia*), amargosa (*Castela erecta*), and catclaw (*Acacia greggii*). Dense bunchgrass pastures may also be used if near thorny shrublands and riparian areas near rivers and creeks have also provided habitat (USFWS, 2013b).

The historical habitat of Gulf Coast jaguarundi has suffered extensive modification. It is estimated that 95 percent of the thornscrub habitat previously present within the Lower Rio Grande Valley of Texas has been converted to agriculture and urban areas. Additionally, roadway collisions and resulting mortalities has been a factor in the decline of this species. A lack designated protected habitat for the species has also contributed to the limited recovery of populations within the U.S. (USFWS, 2013b)

Mexican Long-nosed Bat. The Mexican long-nosed bat is grayish brown in color on its back, with paler shoulders and underparts. It has a long nose with a leaf-like projection on the end, medium sized ears, no tail, and a long and extendable tongue. The Mexican long-nosed bat was federally listed as endangered in 1988 (53 FR 38456 38460, September 30, 1988) with no critical habitat (USFWS, 2016d). The natural range for this bat includes northern and central Mexico and southwestern Texas and New Mexico in areas of upper desert scrub and pine-oak woodlands. In Texas, it is found in near Big Bend the Chinati Mountains in Presidio County southward towards Mexico (TPWD, 2015l).

The Mexican long-nosed bat is migratory in the northern portion of its range, where it relies upon flowering cacti and paniculate agaves as its primary food source. It utilizes caves and rock fissures, hollow trees and manmade structures for day and night roost sites. Population decline and lack of habitat protection, including agave plants, were cited as primary reasons for listing. It is believed that agave and cactus species utilized by Mexican long-nosed bat may be dependent upon the bats for sexual reproduction (Nature Serve Explorer, 2015a).

Ocelot. The ocelot is a medium sized, predatory cat that ranges from the southwestern U.S. to Argentina, although it is very rare in the US. It grows to approximately 35 pounds and has characteristic black spots on a yellow/golden coat. There are currently two subspecies which occur in the US, the Texas/Tamaulipas ocelot (*L. p. albescens*), which occurs in Texas, and the Arizona/Sonora ocelot (*L. p. sonoriensis*), which occurs in Arizona (USFWS, 2010a). Ocelots within the U.S. were listed as endangered in 1982 (75 FR 52547 52549, August 26, 1982) with no critical habitat (USFWS, 2015d).

The ocelot historically had a large range in Texas and Arizona, with the species ranging to the Panhandle in Texas and to Camp Verde, Yavapai County, in Arizona. Now the species is only found in extreme southern Texas and the Sky Island region of southeastern Arizona. The ocelot uses a wide range of habitats and ecosystems in the northern portion of its range; however, within these habitats it is typically limited to microhabitats with dense habitat cover. Because the species has large home ranges, individuals in the U.S. may live primarily across the Mexican border. Threats to the species include habitat alteration/destruction, incidental mortality from predator control, road mortality, disease, and inadequacy of regulatory mechanisms for the species outside the U.S. (USFWS, 2010a).

West Indian Manatee. The West Indian Manatee (*Trichechus manatus*) averages 9 feet in length and weigh about 1,000 pounds (USFWS, 2015e). The manatee was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was grandfathered into the ESA of 1973. The West Indian manatee is also protected under the Marine Mammal Protection Act (MMPA). The USFWS proposed to reclassify the West Indian manatee from endangered to threatened with a public comment period starting on January 8, 2016 (81 FR 1000 1026, January 8, 2016). Following the public comment period, the USFWS downlistened the manatee to threatened on March 16, 2017; Federal Register Number 2015-32645. (Regulations.gov, 2016) The manatee has a large, seal-shaped body with flippers and a large tail, and are typically gray in color

(USFWS, 2015e). Manatees found in mainland U.S. waters are recognized as a separate subspecies known as the Florida manatee (*Trichechus manatus latirostris*) (USFWS, 2001a). The species is found in the Gulf of Mexico from Texas, Louisiana, Mississippi, Alabama, and Florida; and along the Atlantic coast, where the species ranges from Florida north along Georgia and South Carolina to North Carolina. In Texas, the manatee is known or believed to be present in 17 coastal counties (USFWS, 2015e). Critical habitat has only been designated in southern Florida.

West Indian manatees are found in tropical and subtropical coastal and river waters along the southeast U.S. coast, the Caribbean coast of Central and South America, and locally throughout the West Indies. 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). During summer, manatees may be commonly found almost anywhere in Florida with appropriate water depths (3 to 6 feet). "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 boat strikes, decreased availability of warm-water refuges for manatees, and intensive coastal development (USFWS, 2001a).

Reptiles

Three endangered and two threatened reptiles are federally listed for Texas as summarized in Table 15.1.6-5 (USFWS, 2016a) (NPS, 2016a). The Louisiana pine snake (*Pituophis ruthveni*) is a candidate species identified in Texas (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-5: Federally Listed Reptile Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Green Sea Turtle	*Chelonia mydas*	Threatened	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. Found in 14 coastal counties on the Gulf of Mexico in Texas.
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	No	Warm, shallow, coastal waters of reefs, lagoons, inlets, and bays with submerged aquatic vegetation. Found in 14 coastal counties on the Gulf of Mexico in Texas.
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered	No	Nearshore habitats characterized by muddy or sandy bottoms where their prey items can be found, in waters rarely greater than 160 feet deep. Found in 17 coastal counties on the Gulf of Mexico in Texas.
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	No	Mostly open oceans but also coastal waters. Found in 14 coastal counties on the Gulf of Mexico in Texas.
Loggerhead Sea Turtle	*Caretta*	Threatened	No	Open sea environment, but they also occur in inshore area such as salt marshes, creeks, bays, and lagoons. Found in 14 coastal counties on the Gulf of Mexico in Texas.

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

Green Sea Turtle. The green sea turtle is "the largest of all of the hard-shelled sea turtles" (NOAA, 2016b). It was listed as threatened for populations in Texas in 2016 (81 FR 20057 20090, May 6, 2016) (NOAA, 2016a). "Their top shell is smooth with shades of black, gray, green, brown, and yellow; their bottom shell is yellowish white." The adults grow to approximately 3 feet and weight between 300 to 350 pounds. The green sea turtle is found throughout all of the major oceans of the world, but "generally found in tropical and subtropical water along continental coasts and islands between 30 degree North and 30 degree South" (NOAA, 2016b). Critical habitat includes the "waters surrounding the island of Culebra, Puerto Rico" and the island's outlying Keys (USFWS, 2016e).

This species "are the only marine turtles to exclusively eat plants." "They feed primarily on seagrasses and algae." Nesting season typically occurs between June and September, with females laying eggs in 2 to 4 year cycles. " In Florida, green turtle nests contain an average of 135 eggs, which will incubate for approximately 2 months before hatching" (NOAA, 2016b). Current threats to the green sea turtle include "harvest of eggs and adults, incidental capture in fishing gear, fibro papillomatosis (disease)", "loss or degradation of nesting habitat, disorientation of hatchlings by beachfront lighting; nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations" (NOAA, 2016b) (USFWS, 2016e).

Hawksbill Sea Turtle. The hawksbill sea turtle 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 weighing 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, 2015k) (USFWS, 2015f). Even though in the Atlantic Ocean they range from the East Coast of the U.S. to northern Brazil, they are more infrequently found offshore of mid-Atlantic and New England states (NOAA, 2015k). In Texas, the hawksbill sea turtle is known or believed to occur in 14 coastal counties (USFWS, 2015g). Critical habitat has only been designated in waters surrounding Isla Mona and Isla Monito, Puerto Rico (63 FR 46693 46701, September 2, 1998) (USFWS, 1998).

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 and is most often associated with the coral reef community. 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, 2015f).

Current threats to the hawksbill sea turtle include accidental capture in fishing lines, vessel strikes, contaminants, oil spills, disease, habitat loss of coral reef communities, and commercial exploitation. Outside of the US, a current threat is the harvest of their meat and eggs, which was the historic threat to this species causing their decline (NOAA, 2015k).

Kemp's Ridley Sea Turtle. The Kemp's Ridley sea turtle 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, 2014a) (USFWS, 2015h). 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 was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015i). Their range includes the Gulf of Mexico and the U.S. Atlantic seaboard, from New England to Florida. They prefer nearshore habitats characterized by muddy or sandy bottoms where their prey items can be found, in waters rarely greater than 160 feet deep. They feed mostly on crabs, but also consume jellyfish, fish, and an array of mollusks (NOAA, 2014a). In Texas, the Kemp's Ridley sea turtle is known or believed to occur in 17 coastal counties (USFWS, 2015i). No critical habitat has been proposed in Texas (USFWS, 2015i).

Kemp's Ridley sea turtles 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, 2014a). Historically, harvesting of the turtles eggs during their nesting was the main cause for the decline of this species while current threats to this species includes the direct harvest of adults and eggs, accidental capture in fishing gear, recreational activities on beaches, and pollution (USFWS, 2015h).

Leatherback sea turtle Photo credit: USFWS

Leatherback Sea Turtle. The leatherback sea turtle is the deepest-diving and most wide-ranging sea turtle found in all of the world's oceans. It is the largest of all sea turtles, reaching 4 to 8 feet long and weighing 500 to 2,000 pounds (USFWS, 2015j). 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, 2015k). The leatherback sea turtle is capable of tolerating a wide range of water temperatures, and it has the widest global distribution, including parts of the Atlantic, Pacific, and Indian Oceans, and as far north as Newfoundland and south to Argentina. The occurrence in the U.S. is rare for the Atlantic population, with the most significant location within the east coast being in southeastern Florida (NOAA, 2015f) (USFWS, 2015j). In Texas, the leatherback sea turtle is known from or believed to occur in 14 coastal counties (USFWS, 2015k). Critical habitat for the species has only been designated within the U.S. Virgin Islands.

The preferred habitat for this species include open oceans but also occur in coastal waters. The leatherback sea turtle diet consists of jellyfish, salps (a transparent barrel-shaped tunicate[96]), and other soft-bodied animals. This species will forage in both coastal waters and the open sea environment (NOAA, 2015f). For reproduction, female leatherback sea turtles nest at two to three year intervals during the months of March to July. Nest-building occurs during the night and each turtle will nest up to 11 nests per nesting season (USFWS, 2015j). Current major threats to the species include harvesting of sea turtles and their eggs, hunting, incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015f).

Loggerhead Sea Turtle. The loggerhead sea turtle (*Caretta caretta*) can grow to an average length of three feet and weight of 250 pounds. This species has a reddish-brown carapace and flippers, and is characterized by its large head (USFWS, 2015l). 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 and the northwestern Atlantic Ocean population remained listed as threatened (76 FR 58868 58952, September 22, 2011) (USFWS, 2015m).

This turtle is known to occur throughout temperate and tropical regions in the Atlantic, Pacific, and Indian Oceans with the 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 U.S. (USFWS, 2008a). In Texas, the loggerhead sea turtle is known from or believed to occur in 14 coastal counties (USFWS, 2015m). Critical habitat has been designated in Mississippi along the beaches of Horn Island and Petit Bois Island in Jackson County (NOAA, 2014b).

[96] 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."

The preferred habitat for the loggerhead sea turtle is the open sea environment, but they also occur in inshore areas such as salt marshes, creeks, bays, and lagoons. Open beaches are the preferred location for nesting along the coast, and coral reefs and rocky places are the preferred feeding areas (NOAA, 2014c). Current threats to the loggerhead sea turtle include incidental captures in in fishing gear, directed harvesting of eggs, and loss and degradation of habitats (NOAA, 2014c) (USFWS, 2008a).

Birds

There are nine endangered and five threatened avian species that are federally listed and known to occur in Texas as summarized in Table 15.1.6-6. The least tern (*Sterna antillarum*), Eskimo curlew (*Numenius borealis*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and whooping crane (*Grus americana*) are found close to water, while the red-cockaded woodpecker (*Picoides borealis*) and Mexican spotted owl (*Strix occidentalis lucida*) are found in mature forests in eastern and western Texas. The golden-cheeked warbler (*Dendroica chrysoparia*) is found in mixed woodlands in the central part of the state. Attwater's prairie-chicken (*Tympanuchus cupido attwateri*) is only found in two locations in the wild in southeastern Texas. The yellow-billed cuckoo (*Coccyzus americanus*) and the southwestern willow flycatcher (*Empidonax traillii extimus*) are found in riparian areas near wetlands and streams. The black-capped vireo (*Vitreo atricapilla*) is found in brushy hardwood thickets in southwestern Texas, the lesser prairie-chicken (*Tympanuchus pallidicinctus*) is a rare occupant of prairies in the panhandle portion of the state, and the northern aplomado falcon (*Falco femoralis septentrionalis*) is rarely seen in the southwestern grasslands and savannas (USFWS, 2016a). The red-crowned parrot (*Amazona viridigenalis*) is a candidate species found in Texas (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-6: Federally Listed Bird Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Attwater's Greater Prairie-chicken	*Tympanuchus cupido attwateri*	Endangered	No	Coastal prairie habitat in Texas.
Black-capped Vireo	*Vireo atricapilla*	Endangered	No	Brushy thickets of deciduous trees.
Eskimo Curlew	*Numenius borealis*	Endangered	No	Plains and grasslands areas throughout the state near larger bodies of water.
Golden-cheeked Wood Warbler	*Dendroica chrysoparia*	Endangered	No	Mixed deciduous and juniper woodlands on slopes, in drainage bottoms, and in creeks.
Least Tern	*Sterna antillarum*	Endangered	No	Wide, sandy river banks.
Lesser Prairie-chicken	*Tympanuchus pallidicinctus*	Threatened	No	Mixed grass prairie lands.
Mexican Spotted Owl	*Strix occidentalis lucida*	Threatened	No	Dense, old-growth, multistoried, forest habitats in both canyons and in mountains.
Northern Aplomado Falcon	*Falco femoralis septentrionalis*	Endangered	No	Open grassland and savanna with scattered trees.
Piping Plover	*Charadrius melodus*	Threatened	Yes	Open beaches along lakes and rivers throughout the state.
Red Knot	*Calidris canutus rufa*	Threatened	No	Coastlines of large rivers, and wetlands and marshes throughout the state.
Red-cockaded Woodpecker	*Picoides borealis*	Endangered	No	Mature pine forest.
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	No	Dense, multistoried riparian communities associated with rivers, lakes, swamps and other wetlands.
Whooping Crane	*Grus americana*	Endangered/ Non-Essential Experimental Population	Yes	Marshes, wetlands, and river habitats.
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	No	Large, continuous blocks of riparian habitat of cottonwood and willow trees, or mesquite thorn scrub, typically near water.

Sources: (USFWS, 2016b) (USFWS, 2016a) (USFWS, 2015c)

Attwater's Prairie-chicken. The Attwater's prairie chicken is a small brown bird with a short, rounded dark-colored tail and large orange air sacs on both sides of their necks (USFWS, 2015n). The Attwater's prairie chicken was listed as Endangered with Extinction in 1967 (32 FR 4001, March 11, 1967), before the ESA was created. It was then grandfathered in and listed as endangered under ESA in 1973. Attwater's prairie chicken are endemic to Texas and only occur in coastal prairies in the state. Currently, only 50 wild and 150 captive individuals are left (USFWS, 2010b).

Attwater's prairie chicken habitat has been diminished due to habitat destruction and degradation. Additionally, since populations are extremely low, genetic isolation and inbreeding are possible detriments to the recovery of the species (USFWS, 2010b).

Black-capped Vireo. The black-capped vireo is one of the smallest of the vireos, weighing 9 to 10 grams and measuring approximately 4.5 inches in length. The species is sexually dichromatic (sexes are different colorations); males have a black head, olive green back, and white below, with tinged yellowish-green flanks, while females generally have a gray head (USFWS, 1991a). This species was federally listed as endangered in 1987 (52 FR 37420 37423, October 6, 1987). Historic species range extended from south-central Kansas, through central Oklahoma and Texas, and through central Coahuila, Mexico (USFWS, 1991a). Current migratory range in Texas between April and July covers in 69 counties in the central portion of the state (USFWS, 2015o).

Black-capped vireo prefer habitat with varying stratum, including scatter clumps of shrubs such as oak species, in open grassy areas and a high density of deciduous plant species. They have been correlated with of Edwards or Fredericksburg limestone rock formations with the described vegetation. Major threats to the species include habitat destruction and modification and brown-headed cowbird brood parasitism (Owens, 2006).

Eskimo Curlew. The Eskimo curlew is a light brown, medium-sized shorebird of approximately 12 inches in length with a down curved bill, dark crown, and black markings and light yellow undersides. The Eskimo curlew was first listed as endangered 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.) (USFWS, 2015p). Historic migrations showed the curlew leaving its breeding grounds in Alaska and northern Canada in fall and heading across North America south through the Caribbean to the southern coasts of South America for winter - returning to breeding grounds by way of central America and the great plains by spring. The last confirmed sighting of the Eskimo curlew took place in Nebraska in 1987, it was last photographed in Texas in 1982, and there is speculation that the species may have gone extinct. In Texas, it was known historically from 11 coastal counties and Cooke, Fannin, Grayson and Lamar Counties along the Red River of north Texas (TPWD, 2015m).

Threats to the species include loss of habitat in South America to tree plantations, loss of feeding grounds on the plains as grasslands were converted to agriculture, and the loss due to extreme pesticide use of its primary food during migration, the egg cases and nymphs of the now extinct Rocky Mountain grasshopper (*Melanoplus spretus*) (USFWS, 2006).

Golden-cheeked Wood Warbler. The golden-cheeked wood warbler is a small songbird with vibrant yellow cheeks outlined with think black lines that run through the eyeline. The lower abdomen and breast are white with some black streaking and the back is almost entirely black. Individuals weigh on average 0.34 oz. and are about 4.7 in. in length. The golden-cheeked wood warbler nesting habitat is confined to 39 counties within Texas (USFWS, 2015q). Its entire nesting range is located within the state and arrives to breed in mid-March. The species winters in the south, migrating to Mexico, Guatemala, Honduras, and Nicaragua. Golden-cheeked wood warbler are highly dependent upon mature Ashe juniper trees as they use them for food, perching, nesting, and nesting materials (USFWS, 2015q). They may also use tall, dense forest stands containing Texas oak, live oak, post oak, Texas ash, cedar elm, bigtooth maple, and pecan among other species along with the presence and dominance of Ashe juniper. Golden-cheeked wood warbler require mature trees for nesting that are at least 15 ft. tall and a diameter at breast height of 5 inches (TPWD, 1990). No critical habitat has been designated for the species.

Habitat loss and fragmentation are major threats the species because of its specific habitat requirements. Habitat loss is primarily due to urbanization, grazing, and housing developments. Additionally, cowbird brood parasitism has also played a role in the species decline (TPWD, 1990).

Least Tern. The endangered least tern is the smallest member of the gull and tern family. The birds are approximately 9 inches in length. Unlike gulls, terns will dive into the water for small fish. The body of least terns is predominately gray and white, with black streaking on the head. Least terns have a forked tail and narrow pointed wings. Least terns less than a year old have less distinctive black streaking on the head and less of a forked tail (USFWS, 2015r). The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). In Texas, it occupies sand or gravel bars in braided streams or rivers, or similar manmade habitats such beaches or gravel pits; it has been documented in 44 counties throughout the state (USFWS, 1990a) (USFWS, 2015r).

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

Lesser Prairie-chicken. The lesser prairie-chicken is a medium-sized, grayish brown grouse of approximately 16 inches in length. The species is marked with alternating brown and white bands and have tufts of elongated feathers on each side of their neck. The lesser prairie-chicken was federally listed as threatened in 2014 (79 FR 19973 20071, April 10, 2014) although current legislation is challenging this listing (NAS, 2015c) (USFWS, 2015s). No critical habitat has been designated for the species.

Lesser Prairie-chicken Photo credit: USFWS

Historically the lesser prairie-chicken was found throughout the southern plains states of Texas, New Mexico, Oklahoma, Kansas and Colorado, but today, the species ranges in less than 16% of these grasslands (USFWS, 2014c). In Texas, it is known from the Panhandle region, where it has been documented in 25 counties. Primary threats to the species include habitat loss and fragmentation due to development, infrastructure, and land conversion, impacts from oil/gas and wind farms, transmission lines, and recent droughts which dropped the lesser prairie chicken populations by more than half. Additional factors include impacts from invasive plants, predation, and that the species becomes less resilient with greater isolation (USFWS, 2015s).

Mexican Spotted Owl. The Mexican spotted owl is one of three subspecies of the spotted owl (*Strix occidentalis*) that is native to the mountainous regions of the southwestern US. It is characterized by its chestnut brown color, white and brown-spotted abdomen and dark eyes. It has a brown tail with thin white bands and lacks ear tufts. The Mexican subspecies was federally listed as threatened in 1993 (58 FR 14248 14271; March 16, 1993) and afforded critical habitat in 2004 in areas outside of Texas (69 FR 53182 53298; August 31, 2004). No critical habitat has been designated within Texas for the subspecies (USFWS, 2015t).

Mexican spotted owl Photo credit: USFWS

The Mexican spotted owl inhabits dense, old-growth, multistoried, forest habitats in both canyons and in mountains. The subspecies nests in large trees or in rock outcroppings. It uses a diverse array of habitats for foraging and roosting, and some undergo altitudinal migration during winter for nesting. In Texas, the subspecies occupies suitable mountainous or rocky canyon habitat in 9 western counties ranging from the Big Bend north to the border with New Mexico. The two primary threats for this species include the alteration of habitat due to timber harvesting and stand-replacing wildland fire (USFWS, 2012a).

Northern Aplomado Falcon. The endangered northern aplomado falcon is a medium-sized raptor with a gray back, striking black markings on its face around the eyes, a rufous breast, and a long, banded tail (USFWS, 2015u). Northern aplomado falcons are found in southern and western Texas, and in coastal areas of east and south Mexico and Central America to South America (Tweit R. C., 2008). In Texas, the species is present year round and breeds from late February to October. It can be found in open grasslands or savanna with trees and shrubs scattered for perching (TPWD, 2015n). It was listed as endangered under ESA in 1986. No critical habitat has been established for the northern aplomado falcon (USFWS, 2015u).

Threats to northern aplomado falcon include prairie dog poisoning and habitat degradation and elimination. Some research indicates that the species' range coincides with black-tailed prairie dog and after many prairie dogs were poisoned historically and in present time, this could have affected the success of northern aplomado falcon populations. Habitat destruction is also a likely culprit as livestock grazing has greatly decreased the abundance of desert and coastal grasslands (TPWD, 2015n).

Piping Plover. The piping plover is a small, pale brown-colored shorebird with a short beak and black band across the 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 U.S. and Canada, and as threatened in the remainder of its range in the US, which includes the Northern Great Plains, Atlantic and Gulf Coasts, Puerto Rico, and the Virgin Islands (50 FR 50726 50734, December 11, 1985). Piping plovers are known from or believed to occupy much of the state, except for west Texas (USFWS, 2015v). Critical habitat for the piping plover has been designated along coastal areas of the state (USFWS, 2001b).

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, 2015w) (USFWS, 2015x).

Red Knot. The red knot is approximately 9 inches in length with a wing span up to 20 inches, making it among the largest of the small sandpipers (USFWS, 2005a). 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 or more. Some have been documented to fly more than 9,300 miles from south to north every spring and return south in autumn (USFWS, 2005a) (USFWS, 2014d). Red knot is commonly found in the coastal counties of Texas, but may be observed sporadically across the state during migration, particularly in eastern central portions of the state (USFWS, 2015y).

The preferred habitat is intertidal marines, estuaries, and bays. Mussel beds are important food sources, and mussels and other mollusks are consumed year-round, although during migration season, horseshoe crab eggs are a staple (USFWS, 2005a). 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, 2014d).

Red-cockaded Woodpecker. The red-cockaded woodpecker 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 (USFWS, 2015z). 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. It is known from 17 counties in southeastern Texas (USFWS, 2015aa).

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

Southwestern Willow Flycatcher. The southwestern willow flycatcher is a subspecies of the willow flycatcher (*Empidonax traillii*) that is native to the southwestern U.S. and northern Mexico. It is a small grey-brown bird with a relatively large bill, white throat and a yellowish belly. It is typically six inches in length (including tail) and is characterized by its sharp whistling call. The southwestern willow flycatcher was federally listed as endangered in 1995 (60 FR 10695 10715, February 27, 1995) and afforded critical habitat in 2013 (78 FR 343 534 January 3, 2013), with none designated within Texas (USFWS, 2015ab).

Southwestern willow flycatcher Photo credit: USFWS

The southwestern willow flycatcher breeds in riparian communities associated with rivers, lakes, swamps and other wetlands. The species prefers dense, multistoried riparian vegetation and is typically associated with willow (*Salix* spp.) and/or tamarisk (*Tamarix* spp.). The subspecies inhabits suitable habitats in west Texas, though its distribution in the state is in need of “refinement.” (USFWS, 2002). Threats to subspecies are primarily based on changes in riparian vegetation from damming of rivers and streams, livestock grazing, the establishment of invasive non-native plants and insects, a modified fire regime, and climate change. Other threats include parasitism from brown-headed cowbirds (*Molothrus ater*), disease, and habitat fragmentation (USFWS, 2002) (USFWS, 2014e).

Whooping Crane. The whooping crane is large snowy white plumed bird with a black beak and feet. It is the tallest bird of North America, growing to a height of up to five feet. The species was listed as endangered in 1967 (32 FR 4001, February 24, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. § 1531 et seq.) (USFWS, 2015ac). The only self-sustaining population of whooping crane nests in Canada and winters in coastal marshes of Aransas, Calhoun and Refugio Counties of Texas, and critical habitat was designated for the species in these wintering grounds. During migration, the species may be observed through much of Texas with the exceptions of the extreme east or extreme west parts of the state (TPWD, 2016d) (USFWS, 2007a).

Suitable habitat for the whooping crane consists of marshes, wet meadows and prairies, riverine habitats, and agricultural fields. Historically, threats to the whooping crane included hunting, displacement by humans, and loss of habitat. Current reasons for this species' decline are their isolated populations, loss and degradation of migration habitat, impacts from powerlines and their construction, degradation of coastal ecosystems, and chemical spills (USFWS, 2007a).

Western Yellow-billed Cuckoo The yellow-billed cuckoo is approximately 12 inches in length and weighs approximately two ounces. It is a shy, migrant bird that winters in South America and breeds in the U.S. Widely distributed across the US, the species has recently been divided into two distinct population segments (DPSs): western and eastern. The western DPS is found generally west of the Rocky Mountains and/or Pecos River (USFWS, 2013d). The western DPS was federally listed as threatened in 2014 (79 FR 59991 60038, October 3, 2014) and has been proposed critical habitat in eight western states (79 FR 48547 48652; August 15, 2014) (USFWS, 2015ad). Currently, the western yellow-billed cuckoo is known to breed in Arizona, California, Colorado, Idaho, New Mexico, Nevada, and Utah (Johnson, 2009). In Texas, the species historically inhabited parts of the state west of the Pecos River, particularly along the Rio Grande, where critical habitat has been proposed at two locations (Johnson, 2009) (USFWS, 2015ad).

Yellow-billed cuckoo Photo credit: USFWS

Western yellow-billed cuckoos inhabit large, continuous blocks of riparian habitat of cottonwood (*Populus* spp.) and willow trees (*Salix* spp.) or mesquite (*Prosopis* spp.) thorn scrub, typically near water. The yellow-billed cuckoo breeds in forested areas with significant canopy cover (Johnson, 2009). Loss of suitable forested habitat along streams and rivers due to habitat fragmentation, invasion of invasive species, and conversion of land to other uses are considered the primary threats to this species (Johnson, 2009) (USFWS, 2015ad).

Fish

There are nine endangered and two threatened fish species federally listed in Texas as summarized in Table 15.1.6-7. The Arkansas River shiner (*Notropis girardi*) occurs in northern Texas. The Bigbend Gambusia (*Gambusia gaigei*), Leon Springs pupfish (*Cyprinodon bovinus*), Comanche Springs pupfish (*Cyprinodon elegans*), Devils River minnow (*Dionda diaboli*), and Pecos gambusia (*Gambusia nobilis*) occur in southwest Texas. The Clear Creek gambusia (*Gambusia heterochir*) and San Marco gambusia (*Gambusia georgei*) occur in southern Texas. The Fountain darter (*Etheostoma fonticola*) is found in central Texas. The sharpnose shiner (*Notropis oxyrhynchus*) and smalleye shiner (*Notropis buccula*) occur in north central Texas (USFWS, 2016a). In addition, an experimental population of the endangered Rio Grande silvery minnow (*Hybognathus amarus*) occurs in southwest Texas (USFWS, 2016f). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-7: Federally Listed Fish Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Arkansas River Shiner	*Notropis girardi*	Threatened	No	Large and medium rivers.
Big Bend Gambusia	*Gambusia gaigei*	Endangered	No	Clear, shallow pools and marshes in Big Bend National Park.
Clear Creek Gambusia	*Gambusia heterochir*	Endangered	No	Spring fed headwaters of Clear Creek in Menard County, Texas
Comanche Springs Pupfish	*Cyprinodon elegans*	Endangered	No	Flowing water from desert springs near Balmorhea, Texas.
Devils River Minnow	*Dionda diaboli*	Threatened	Yes	Flowing water with gravel substrates and is only found in San Felipe Creek, Pinto Creek and in the headwaters of the Devils River.
Fountain Darter	*Etheostoma fonticola*	Endangered	Yes	Spring Lake and San Marcos Rivers in Hays County, Texas
Leon Springs Pupfish	*Cyprinodon bovinus*	Endangered	Yes	Diamond Y Spring, the Diamond Y Spring outflow, and portions of Leon Creek in Pecos County, Texas.
Pecos Gambusia	*Gambusia nobilis*	Endangered	No	Springheads and spring runs, or areas with abundant overhead cover, sedge covered marshes, and gypsum sinkholes, to depths of approximately 3 meters.
San Marcos Gambusia	*Gambusia georgei*	Endangered	Yes	Slow moving water with muddy substrate and thermal consistency along the San Marcos River between Interstate Highway 35 and the USGS gaging station downstream from Thompson's Island.
Sharpnose Shiner	*Notropis oxyrhynchus*	Endangered	Yes	The Upper Brazos River, flowing through 11 counties in north central Texas
Smalleye Shiner	*Notropis buccula*	Endangered	Yes	The Upper Brazos River, flowing through 11 counties in north central Texas

Source: (USFWS, 2016a) (USFWS, 1985a) (USFWS, 2015c).

Arkansas River Shiner. The Arkansas River shiner is a small minnow, measuring up to 2 inches in length. This species has a light tan back, silvery sides, and a white belly. Distinguishing features include a rounded snout and a dark mark at the base of the tail fin (USFWS, 2001c). The Arkansas River shiner was federally listed as threatened in 1998 (63 FR 64772 64799, November 23, 1998). Regionally, this species is known to occur in Arkansas, Kansas, New Mexico, Oklahoma, and Texas. In Texas, this species is known or believed to occur in 15 counties of the Panhandle (USFWS, 2015ae). Critical habitat has been designated for the Arkansas River shiner in Kansas and Oklahoma but not in Texas (70 FR 59808 59846, October 13, 2005).

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

Big Bend Gambusia. The Big Bend gambusia is a small, livebearer averaging about 2 inches in length (TPWD, 2015o). The species can only be found in Brewster County, Texas near Boquilla Crossing and Rio Grande Village in Big Bend National Park (TPWD, 2015o) (USFWS, 2015af). The Big Bend gambusia was federally listed as endangered in 1967 (67 FR 2758, March 10, 1967). To date, no critical habitat has been designated for this species. Big Bend gambusia feed on aquatic invertebrate species and can be found in natural pools and marshes with clear, shallow waters (TPWD, 2015o). Threats to this species include changes in spring flow and water quality (USFWS, 2015af).

Clear Creek Gambusia. The Clear Creek gambusia is a small, livebearer averaging about 2 inches in length that feeds on small invertebrates. The species can only be found in the spring fed headwaters of Clear Creek in Menard County, Texas. The species inhabits areas with dense aquatic vegetation and constant water temperatures. The primary threat the species is manmade impoundments that alter spring habitats (TPWD, 2015p) (USFWS, 2015ag). The Clear Creek gambusia was federally listed as endangered in 1967 (32 FR 4001, March 11, 1967). To date no critical habitat has been designated for this species (USFWS, 2015ag).

Comanche Springs Pupfish. The Comanche Springs Pupfish is small freshwater fish endemic to Texas. The species averages about two in. in length and has a bright shiny stripe on the side. The species inhabits flowing water from desert springs and feeds on small invertebrates and aquatic vegetation. The Comanche Springs pupfish only exists in springs located in west Texas, near Balamorhea, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (TPWD, 2015q). The Comanche Springs pupfish was federally listed as endangered in 1967 (67 FR 2758, March 10, 1967). To date no critical habitat has been designated for this species (USFWS, 2016g).

Devils River Minnow. The Devils River Minnow is small freshwater fish endemic to Texas. The species averages about two inches in length and has a pronounced black tail spot. The species inhabits flowing water with gravel substrates from desert springs and feeds partially on aquatic vegetation. Currently, the Devils River minnow can only be found in San Felipe Creek, Pinto Creek and in the headwaters of the Devils River. The primary threat to the species is loss of spring habitat due to drought and groundwater extraction for human activities (TPWD, 2015r) (USFWS, 2015ah). The Devils River Minnow was federally listed as threatened in 1999 (64 FR 56596 56609, October 20, 1999). Critical habitat has been designated for this the Devils River minnow in streams located in Val Verde and Kinney Counties, Texas (73 FR 46988 47026, August 12, 2008).

Fountain Darter. The endangered Fountain darter is small freshwater fish endemic to Texas. The species averages less than 1 inch in length and inhabits flowing water from desert springs where mats of green algae exist. The species feeds on small invertebrates and has a lifespan of two years. The Fountain darter only exists in the spring fed San Marcos and Comal River headwaters in Hays and Comal Counties, Texas. The primary threat to the species is loss of spring habitat due to groundwater extraction for human activities (TPWD, 2015s). The fountain darter was federally listed as endangered in 1970 (35 FR 16047 16048, October 13, 1970) and critical habitat for the species was officially designated in 1980 (45 FR 47355 47364, July 14, 1980). Critical habitat consists of Spring Lake, the Spring Lake outflow, and portions of the San Marcos River in Hays County, Texas (USFWS, 1980).

Leon Springs Pupfish. The Leon Springs pupfish is small freshwater fish endemic to Texas. The species averages approximately two inches in length and inhabits slow flowing waters such as spring fed marshes and pools with a mud substrate. The species feeds primarily decomposed organic matter. The Leon Springs Pupfish only exists in the Diamond Y Spring in Pecos County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (TPWD, 2015t). The Leon Springs pupfish was federally listed as endangered and critical habitat formally designated for the species in 1980 (45 FR 54678 54681, August 15, 1980). Critical habitat for the species consists of Diamond Y Spring, the Diamond Y Spring outflow, and portions of Leon Creek in Pecos County, Texas (USFWS, 2016h).

Pecos Gambusia. Pecos gambusia is a small, light reddish-brown live-bearing fish with a flattened head and protruding lower jaw. The species was federally listed as endangered in 1970 (35 FR 16047 16048; October 13, 1970). The Pecos gambusia is endemic to springs and spring systems on the western slope of the Pecos River basin of southeastern New Mexico and western Texas. In Texas the Pecos Gambusia is found in Jeff Davis and Pecos Counties in the western portion of the state near Fort Stockton, Texas (TPWD, 2015u) (USFWS, 2015ai) (USFWS, 1983).

Pecos gambusia habit consists of springheads and spring runs, or areas with abundant overhead cover, sedge covered marshes, and gypsum sinkholes, to depths of approximately 3 meters. Threats to the species includes loss of habitat (dewatering or diverting of springs) and introduction of non-native species, resulting in increased predation and competition (USFWS, 1983).

San Marcos Gambusia. San Marcos gambusia is a light grey or brown fish with a “dark stripe along the edges of their dorsal fin” and a flattened head and protruding lower jaw (USFWS, 1985a). The species was federally listed as endangered in 1980 (45 FR 47355 47364; July 14, 1980) (USFWS, 2016i). “The San Marcos gambusia is restricted to the approximately 1 km portion of the San Marcos River between Interstate Highway 35 and the USGS gaging station immediately downstream from Thompson's Island" (USFWS, 1985a).

San Marcos gambusia habit consists of slow moving water with muddy substrate and thermal consistency. Threats to the species includes loss of habitat (changes in water temperatures) and introduction of non-native species, resulting in increased predation and competition (USFWS, 1985a).

Sharpnose Shiner. The Sharpnose Shiner is small freshwater minnow endemic to the prairie streams of Texas. The species averages less than two inches in length and inhabits shallow river and stream reaches with a sandy substrate. The species are considered generalist feeders and that require flowing water for successful reproduction. The sharpnose shiner only exists the Brazos River basin upstream of Possum Kingdom Reservoir in north central Texas. The primary threat the species is habitat alteration and change of flow regime due to manmade impoundments and groundwater extraction for human activities (USFWS, 2014f) (USFWS, 2015aj). The Sharpnose Shiner was federally listed as endangered in 2014 (79 FR 45273 45286, August 4, 2014). In addition 623, miles of the upper Brazos River Basin, flowing through 11 counties, was designated as critical habitat for the Sharpnose shiner in 2014 (79 FR 45241 4527, August 4, 2014) (USFWS, 2014g).

Smalleye Shiner. The smalleye shiner is small freshwater minnow, very similar to the sharpnose shiner, endemic to the prairie streams of Texas. The species averages less than two inches in length and inhabits shallow river reaches with a sandy substrate. The species are considered generalist feeders and that require flowing water for successful reproduction. The smalleye shiner occupies much of the same habitat as the sharpnose shiner and only exists the Brazos River basin upstream of Possum Kingdom Reservoir in north central Texas. The primary threat the species is habitat alteration and change of flow regime due to manmade impoundments and groundwater extraction for human activities (USFWS, 2014f) (USFWS, 2015aj). The smalleye shiner was federally listed as endangered in 2014 (79 FR 45273 45286, August 4, 2014). In addition, 623 miles of the upper Brazos River Basin flowing through 11 counties was designated as critical habitat for the smalleye shiner in 2014 (79 FR 45241 4527, August 4, 2014) (USFWS, 2014g).

Amphibians

There are four endangered and four threatened amphibian species federally listed in Texas as summarized in Table 15.1.6-8. Seven of the listed species are salamanders and one is a toad. All eight species of listed amphibians occur in central Texas (USFWS, 2016a). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-8: Federally Listed Amphibian Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Austin Blind Salamander	*Eurycea waterlooensis*	Endangered	Yes	Springs, spring-runs, caves, and groundwater pools of Barton Springs in Travis County, Texas.
Barton Springs Salamander	*Eurycea sosorum*	Endangered	No	Clean flowing water from springs, spring-runs, caves, and groundwater pools in Barton Springs portion of the Edwards Aquifer.
Georgetown Salamander	*Eurycea naufragia*	Threatened	No	Surface and subsurface flowing waters from springs, spring-runs, caves, and groundwater pools in Williamson County, Texas.
Houston Toad	*Bufo houstonensis*	Endangered	Yes	Inhabits dry upland forests and prairies near still or slow moving waters in southern Texas.
Jollyville Plateau Salamander	*Eurycea tonkawae*	Threatened	Yes	Brushy creek areas of the Edwards Plateau in Travis and Williamson Counties, Texas.
Salado Salamander	*Eurycea chisholmensis*	Threatened	No	Springs, spring-runs, caves, and groundwater pools in Bell County, Texas.
San Marcos Salamander	*Eurycea nana*	Threatened	Yes	Flowing spring waters of a constant temperature. Found in Spring Lake and the San Marcos River in Hays County, Texas.
Texas Blind Salamander	*Typhlomolge rathbuni*	Endangered	No	Inhabits clean flowing underground waters of a constant temperature.

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

Austin Blind Salamander. The Austin blind salamander is a lungless salamander with external gills endemic to Texas. The species inhabits springs, spring-runs, caves, and groundwater pools. The Austin blind salamander requires excellent water quality for survival and can now only be found in the Barton Springs portion of the Edwards Aquifer located in Travis County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (USFWS, 2015ak). The Austin blind salamander has been federally listed since 2013 (8 FR 5385 5403, March 26, 2014). Critical habitat was also formally designated for the species in 2013 in Travis County, Texas (78 FR 51327 51379, August 20, 2013). Critical habitat includes both surface and subsurface areas of Barton springs in central Travis County (USFWS, 2013e).

Barton Springs Salamander. The Barton Springs salamander is a lungless salamander with external gills that does not transform into a terrestrial form. The species is endemic to Texas and is characterized by bright red gills, elongated limbs, and a flattened snout. The species inhabits clean flowing water from springs, spring-runs, caves, and groundwater pools. The Barton Springs salamander requires excellent water quality for survival and can now only be found in the Barton Springs portion of the Edwards Aquifer located in Travis County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (USFWS, 2015al). The Barton Springs salamander has been federally listed since 1997 (62 FR 23377 23392, May 30, 1997). To date no critical habitat has been officially designated for this species (USFWS, 2015al).

Georgetown Salamander. The Georgetown salamander is an approximately two inch long lungless salamander with external gills. The species is endemic to Texas and inhabits clean flowing water from springs, spring-runs, caves, and groundwater pools. The Georgetown salamander requires excellent water quality for survival and can now only be found in the northern portion of the Edwards Aquifer located in Williamson County, Texas. The species is known to exist at 17 locations all of which are inside the incorporated area of the City of Georgetown. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (USFWS, 2015am). The Georgetown salamander has been federally listed as threatened (79 FR 20107 20108, February 24, 2014). In 2013, critical habitat was proposed for the species (78 FR 5385 5403, January 25, 2013). To date, no critical habitat has been officially designated for this species (USFWS, 2015am).

Houston Toad. The Houston toad is an approximately three inch long toad with color varying from light brown to gray, and often with some green colored patches. The species is endemic to Texas and inhabits dry upland forests and prairies. The toad often burrows into the sand for protection from the elements. The Houston Toad does require still or slow moving waters for successful reproduction. Currently, the species can only be found in nine Texas counties near Austin, Texas. The primary threat the species is loss or alteration of breeding habitat such as wetlands (TPWD, 2015v) (USFWS, 2015an). The Houston Toad has been federally listed as endangered since 1970 (35 FR 16047 16048, October 13, 1970) and in 1978 critical habitat was officially designated for the species (43 FR 4022 4026, January 31, 1978). Critical habitat consists of a single square mile of land near the entrance to Lake Woodrow in Burleson County, Texas (USFWS, 1978).

Jollyville Plateau Salamander. The Jollyville Plateau salamander is an approximately two inch long lungless salamander with external gills and is very similar to the Austin blind salamander. The species is endemic to Texas and inhabits clean flowing water from springs, spring-runs, caves, and groundwater pools. The Jollyville Plateau salamander requires excellent water quality for survival and can now only be found in brushy creek areas of the Edwards Plateau in Travis and Williamson Counties, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (USFWS, 2015ao). The Jollyville Plateau salamander has been federally listed as threatened since 2013 (8 FR 5385 5403, September 19, 2013). Critical habitat was also formally designated for the species in 2013 in Travis County, Texas (78 FR 51327 51379, August 20, 2013). Critical habitat includes both surface and subsurface areas of 32 units located in central Travis and Williamson Counties, Texas (USFWS, 2013e).

Salado Salamander. The Salado salamander is an approximately two inch long lungless salamander with external gills and is very similar to the Georgetown salamander. The body is generally a gray-brown color with a light cinnamon tinge. The species is endemic to Texas and inhabits clean flowing water from springs, spring-runs, caves, and groundwater pools. The Salado salamander requires excellent water quality for survival and can now only be found at four spring sites in the northern portion of the Edwards Aquifer located in Bell County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (USFWS, 2015ap). The Salado salamander has been federally listed as threatened since 2014 (79 FR 20107 20108, March 26, 2014); in 2012, critical habitat was proposed for the species (77 FR 50767 50854, January 25, 2013). To date, no critical habitat has been officially designated for this species (USFWS, 2015ap).

San Marcos Salamander. The San Marcos salamander is a dark- to reddish-brown salamander that can reach up to two inches in length. The species is endemic to Texas and inhabits clean flowing spring waters of a constant temperature. The San Marcos salamander requires excellent water quality for survival and can now only be found in Spring Lake and the downstream portion of the San Marcos River in Hays County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (TPWD, 2015w) (USFWS, 2015aq). The San Marcos salamander has been federally listed as threatened since 1980 when critical habitat was also designated for the species (45 FR 47355 47364, July 14, 1980). Critical habitat consists of Spring Lake, the Spring Lake outflow, and portions of the San Marcos River in Hays County, Texas (USFWS, 1980).

Texas blind Salamander. The Texas blind salamander is an eyeless salamander with little to no skin pigment that can reach up to two inches in length. The species is endemic to Texas and inhabits clean flowing underground waters of a constant temperature. The Texas blind salamander requires excellent water quality for survival and can now only be found in select water filled caves in the Edwards Aquifer located in Hays County, Texas. The primary threat the species is loss of spring habitat due to groundwater extraction for human activities (TPWD, 2015x) (USFWS, 2015ar). The Texas blind salamander has been federally listed as endangered since 1967 (32 FR 4001, March 11, 1967). No critical habitat has been formally designated for this species (USFWS, 2015ar).

Invertebrates

There are 27 endangered invertebrate species federally listed in Texas as summarized in Table 15.1.6-9 (USFWS, 2016a). These species occur throughout Texas. Texas fatmucket (*Lampsilis bracteata*), Texas fawnfoot (*Truncilla macrodon*), Texas hornshell (*Popenaias popeii*), Golden orb (*Quadrula aurea*), smooth pimpleback (*Quadula houstonensis*), and Texas pimpleback (*Quadrula petrina*) are candidate species believed to or known to occur in Texas (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-9: Federally Listed Invertebrate Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
(No common name) Beetle	*Rhadine exilis*	Endangered	Yes	Limestone caves occurring in Bexar County, Texas
(No common name) Beetle	*Rhadine infernalis*	Endangered	Yes	Limestone caves occurring in Bexar County, Texas
American Burying Beetle	*Nicrophorus americanus*	Endangered	No	Flat, forested areas in the eastern third of the state.
Bee Creek Cave Harvestman	*Texella reddelli*	Endangered	No	Dry Limestone caves with at least some groundwater influx.
Bone Cave Harvestman	*Texella reyesi*	Endangered	No	Dry Limestone caves with at least some groundwater influx.
Braken Bat Cave Meshweaver	*Cicurina venii*	Endangered	Yes	Limestone caves in the Culebra Anticline karst region.
Coffin Cave Mold Beetle	*Batrisodes texanus*	Endangered	No	Isolated caves in the Edwards limestone formation.
Cokendolpher Cave Harvestman	*Texella cokendolpheri*	Endangered	Yes	Isolated caves in the Edwards limestone formation.
Comal Springs Dryopid Beetle	*Stygoparnus comalensis*	Endangered	Yes	Comal Springs in Hays County Texas.
Comal Springs Riffle Beetle	*Heterelmis comalensis*	Endangered	Yes	San Marco Springs in Hays County Texas.
Diamond Tryonia	*Pseudotryonia adamantina*	Endangered	Yes	Mud substrates of spring margins and associated seeps.
Diminutive Amphipod	*Gammarus hyalleloides*	Endangered	Yes	Four desert springs in Jeff Davis and Reeves Counties, Texas.
Gonzales Tryonia	*Tryonia circumstriata stocktonensis*	Endangered	Yes	Muddy substrates of small springs.
Government Canyon Bat Cave Meshweaver	*Cicurina vespera*	Endangered	Yes	Government Canyon Bat Cave in Bexar County, Texas.
Government Canyon Bat Cave Spider	*Neoleptoneta microps*	Endangered	Yes	Two caves in Bexar County Texas.
Helotes Mold Beetle	*Batrisodes venyivi*	Endangered	Yes	Eight limestone caves occurring in Bexar County, Texas.
Kretschmarr Cave Mold Beetle	*Texamaurops reddelli*	Endangered	No	Three limestone caves in Travis County, Texas.
Madla’s Cave Meshweaver	*Cicurina madla*	Endangered	Yes	Eight limestone caves occurring in Bexar County, Texas.
Peck’s Cave Amphipod	*Stygobromus pecki*	Endangered	Yes	Saturated, moist soil at the edges of streams or spring runs, and in wet mud or under mats of vegetation in 1 inch of flowing water. Found in Chaves County, southeastern New Mexico.
Pecos Assiminea Snail	*Assiminea pecos*	Endangered	Yes	Muddy substrates at the margins of springs. Found in Diamond Y Springs and East Sandia Springs in Pecos and Reeves Counties, Texas, respectively.
Pecos Amphipod	*Gammarus pecos*	Endangered	Yes	Springs and brooks.

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Phantom Springsnail	*Pyrgulopsis texana*	Endangered	Yes	Hard substrates of artesian springs. Found in only in a small pool at the mouth of Phantom Cave near Balmorhea, Texas.
Phantom Tryonia	*Tryonia cheatumi*	Endangered	Yes	Hard and soft substrates in the margins of spring flows.
Robber Baron Cave Meshweaver	*Cicurina baronia*	Endangered	Yes	Robert Baron Cave in Bexar County, Texas.
Tooth Cave Ground Beetle	*Rhadine persephone*	Endangered	No	Deep uncompacted silts within the cave system. Found in 27 locations in Travis and Williamson Counties, Texas.
Tooth Cave Spider	*Leptoneta myopica*	Endangered	No	Tooth Cave in Travis County, Texas.
Tooth Cave Pseudoscorpion	*Tartarocreagris texana*	Endangered	No	The undersides of rocks in Tooth and Amber Caves in Travis County, Texas.

Sources: (USFWS, 2016b) (USFWS, 2016a) (USFWS, 2015c)

Rhadine exilis (no common name – beetle). *Rhadine exilis* is a small eyeless beetle that is endemic to Texas. The beetle is known to occur in 35 caves in Bexar, County Texas. Suitable caves must maintain high humidity and stable temperatures. The primary threat to the species is habitat loss from urbanization. The beetle has been federally listed since 2000 (65 FR 81419 81433 December 6, 2000) (Nature Serve Explorer, 2015b) (USFWS, 2015as). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012).

Rhadine infernalis (no common name – beetle). *Rhadine infernalis* is a small eyeless ground beetle found only in 25 caves of Bexar County Texas. Suitable caves must maintain high humidity and stable temperatures. The primary threat to the species is habitat loss from urbanization (Nature Serve Explorer, 2015c) (USFWS, 2015at). The beetle has been federally listed since 2000 (65 FR 81419 81433 December 6, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012).

American Burying Beetle. The American burying beetle is the largest carrion beetle in North America with a length of between one to two inches with a shiny black shell, smooth shiny black legs, with pronounced orange markings on its body and orange club shaped antennae. The beetle buries carcasses to feed its larvae and upon which it feeds while caring for its young. The species was listed as endangered in 1989 (54 FR 29652 29655, July 13, 1989) (USFWS, 1991b).

The American burying beetle can be found in flat topography with forest litter and decomposing plant matter in the top layers of well-drained soil. Historically the species ranged in more than 150 counties in 35 states of the eastern and central U.S. (USFWS, 2015au), but today is found in 5 distinct populations across 10 states. In 2012, Missouri established a non-essential experimental population with efforts to reintroduce the American burying beetle. In Texas, the American burying beetle is found in Lamar and Red River Counties along the Red River. Threats to the species include habitat loss, fragmentation, and overall loss of reduction of small vertebrates to host the species (USFWS, 2015au).

Bee Creek Cave Harvestman. The Bee Creek Cave Harvestmen is an eyeless light yellowish brown harvestman that inhabits select Limestone caves in Travis and Williamson Counties Texas. Little is currently known about the life history or ecology of this species. The primary threat to the species is habitat modification or alteration from commercial development. The species has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a) (USFWS, 2015av). To date no critical habitat has been designated for this species (USFWS, 2015av).

Bone Cave Harvestman. The Bone Cave Harvestmen is an eyeless harvestman that is known to inhabit 168 caves in Travis and Williamson Counties. Little is currently known about the life history or ecology of this species. The primary threat to the species is habitat modification or alteration from commercial development. Exotic predators like the red imported fire ant are also believed to pose a threat to the species. The species has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a) (USFWS, 2015aw). To date no critical habitat has been designated for this species (USFWS, 2015aw).

Braken Bat Cave Meshweaver. The Bat Cave meshweaver has only been document in a single cave in Texas, which was filled during a home construction in 1990. However, an alternate cave passage has been found. Little is currently known about this species. The primary threat to the Bat Cave meshweaver is habitat modification or alteration from commercial development. The species has been listed since 2000 (65 FR 81419 81433 December 6, 2000) and critical habit was designated for the species in 2012 (77 FR 8450 8523, February 14, 2012) (65 FR 81419 81433, December 6, 2000) (USFWS, 2000) (USFWS, 2012b) (USFWS, 2015ax).

Coffin Cave Mold Beetle. The Coffin Cave mold beetle is an eyeless beetle that spends its entire life in a few isolated caves in Texas. The species inhabits the undersides of limestone rocks with a covering of silt. The species has been listed since 1988 (53 FR 36029 36033, September 16, 1988). Primary threats to the beetle species include habitat modification or alteration from commercial development (USFWS, 1988a) (USFWS, 2015ay).

Cokendolpher Cave Harvestman. The Cokendolpher Cave Harvestman is a small eyeless cave spider that spends its entire life underground. The species inhabits only a handful of caves in the Edwards limestone formation. The Cokendolpher Cave Harvest man has been federally listed as endangered since 2000 (65 FR 81419 81433, December 26, 2000). Critical habitat for the species was officially designated in 2012 (77 FR 8450 8523, February 14, 2012) and consists of karst habitat in Bexar County, Texas (USFWS, 2012b).

Comal Springs Dryopid Beetle. The Comal Springs drypoid beetle is an eyeless subaquatic beetle that only exists in Comal Springs and Fen Banks Springs in Hays County. Comal Springs for the headwaters of the Comal River. The primary threat to this species is a drop in water level of the springs due to human extraction of the Edwards aquifer (USFWS, 2015az). The beetle has been federally listed as endangered since 1997 (62 FR 66295 66304, December 18, 1997) and critical habitat was officially designated for the species in 2007 (72 FR 39248 39283, July 17, 2007). Critical habitat consists of two spring flows of excellent water quality in Hays County, Texas (USFWS, 2007b).

Comal Springs Riffle Beetle. The Comal Springs riffle beetle is a small, flightless, aquatic beetle that is only known to exist in a handfull of spring flows in Hays and Comal Counties. The primary threat to this species is a drop in water level due to human extraction of the Edwards aquifer (USFWS, 2015ba). The beetle has been federally listed as endangered since 1997 (62 FR 66295 66304, December 18, 1997) and critical habitat was officially designated for the species in 2007 (72 FR 39248 39283, July 17, 2007). Critical habitat consists of two locations at San Marcos Springs and Comal Springs in Hays and Comal Counties, Texas (USFWS, 2007b).

Diamond Tryonia. The diamond tryonia is a very small thermal spring snail known to exist only in a spring and associated seeps near Fort Stockton, Texas. The snail is believed to have a lifespan of between 9 and 15 months. The species inhabits the mud substrates of spring margins and associated seeps. The most prominent threat to the diamond tryonia is spring habitat loss due to groundwater extraction for agriculture (USFWS, 2015bb). In 2013, the species was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat consists of Diamond Y Springs and portions of Leon Creek in Pecos County, Texas (USFWS, 2013f).

Diminutive Amphipod. The diminutive amphipod is known to exist in four desert springs located in Jeff Davis and Reeves Counties, Texas. The species is found underneath rocks and within gravels of flowing water. The most prominent threat to the diminutive amphipod is habitat loss due to groundwater extraction for agriculture (USFWS, 2015bc). In 2013, the species was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat consists of portions of Phantom Lake Spring, East Sandia Spring, San Solomon Spring, and Griffin Spring in Reeves and Jeff Davis Counties, Texas (USFWS, 2013f).

Gonzales Tryonia. The Gonzales tryonia is a medium- to large-sized freshwater springsnail that inhabits the muddy substrates of small desert limestone springs. The species is only known to occur in the Dimond Y Spring system of Pecos County, Texas. The primary threat to this species is habitat alteration or loss due to excessive groundwater extraction for agriculture and other purposes (USFWS, 2015be). In 2013, the species was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat is the same as that of the Diamond Y tryonia and consists of Diamond Y Springs and portions of Leon Creek in Pecos County, Texas (USFWS, 2013f).

Government Canyon Bat Cave Meshweaver. The Government Canyon Bat Cave meshweaver is an eyeless subterranean spider. The species is only known to exist in the Government Canyon Bat Cave in Bexar County, Texas. The species prefers caverns with stable temperatures and high humidity. Little is currently known about the life history or ecology of the species. The primary threat to the Government Canyon Bat Cave meshweaver is habitat loss from urbanization (USFWS, 2015bf). The beetle has been federally listed since 2000 (65 FR 81419 81433 December 6, 2000) (USFWS, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012) (USFWS, 2012b).

Government Canyon Bat Cave Spider. The Government Canyon Bat Cave spider is a small, eyeless spider that is only known to occur in two caves in Bexar County Texas. Little is currently known about the life history or ecology of the species. Like other Bexar County invertebrates the Government Canyon Bat Cave Spider prefers caverns with stable temperatures and high humidity. The primary threat to the species is habitat loss from urbanization (USFWS, 2016j). The beetle has been federally listed since 2000 (65 FR 81419 81433, December 6, 2000) (USFWS, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012) (USFWS, 2012b).

Helotes Mold Beetle. The Helotes mold beetle is a small eyeless beetle with a reddish color that resembles and ant. The beetle is known to exist in eight caves in Bexar County, Texas. Like other Bexar County invertebrates, the Helotes Mold Beetle prefers caverns with stable temperatures and high humidity. Little is currently known about the life history or ecology of the species. The primary threat to the species is habitat loss from urbanization (USFWS, 2015bg). The beetle has been federally listed since 2000 (65 FR 81419 81433 December 6, 2000) (USFWS, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012) (USFWS, 2012b).

Kretschmarr Cave Mold Beetle. The Kretschmarr Cave mold beetle is a dark colored subterranean beetle only known to exist in Kretschmarr, Amber, and Tooth Caves in Travis County, Texas. The beetle inhabits caves in an isolated portion of the Edwards Limestone Formation. Little is currently known about the life history or ecology of this beetle. The primary threat to the species is habitat loss from urbanization (USFWS, 2015bh). The species has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a). To date, no critical habitat has been designated for this species (USFWS, 2015bh).

Madla's Cave Meshweaver. The Madla's Cave meshweaver is a small essentially eyeless cave spider. This species of meshweaver is only known to exist in eight caves in Bexar County, Texas. Like other Bexar County invertebrates the Madla's Cave meshweaver prefers caverns with stable temperatures and high humidity. Little is currently known about the life history or ecology of the species. The primary threat to the species is habitat loss from urbanization. The beetle has been federally listed since 2000 (65 FR 81419 81433, December 6, 2000) (USFWS, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012) (USFWS, 2012b).

Peck's Cave Amphipod. Peck's Cave amphipod is an eyeless, unpigmented amphipod that is only known to exist in Comal Springs and Hueco Springs in Comal County, Texas. Little is currently known about the life history or ecology of this amphipod. The primary threat to this species is habitat alteration or loss due to excessive groundwater extraction for agriculture and other purposes (USFWS, 2015bi). The amphipod has been federally listed as endangered since 1997 (62 FR 66295 66304, December 18, 1997) and critical habitat was officially designated for the species in 2007 (72 FR 39248 39283, July 17, 2007). Critical habitat consists of the spring flows from Comal Springs and Hueco Springs in Comal County, Texas (USFWS, 2007b).

Pecos Assiminea Snail. The Pecos assiminea snail is 0.06 to 0.07 inches long, with a thin, almost transparent chestnut-brown colored shell that is conical with an oval opening (USFWS, 2015bj). It was federally listed as endangered in 2005 (70 FR 46304 46333, August 9, 2005), and critical habitat redesignated in 2011 (76 FR 33036 33064, June 7, 2011) in Pecos and Reeves

Counties, Texas. Regionally, this species is found in New Mexico and Texas. In Texas, it is found in Diamond Y Springs and East Sandia Springs in Pecos and Reeves Counties, Texas, respectively (USFWS, 2015bj)

It inhabits saturated, moist soil at the edges of streams or spring runs, and in wet mud or under mats of vegetation in 1 inch of flowing water. Threats to the Pecos assiminea snail include loss of spring flow, contaminants, and the introduction of nonnative species (USFWS, 2005b).

Pecos Amphipod. The Pecos amphipod is a subaquatic amphipod that inhabits limestone springs and the associated outflows in west Texas. Little is currently known about the life history or ecology of this amphipod. The primary threat to this species is loss or alteration of spring habitat due to excessive groundwater extraction for agriculture and other purposes. In 2013, the Pecos amphipod was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat consists of Diamond Y Spring and portions of Leon Creek in central Pecos County, Texas (USFWS, 2013f).

Phantom Springsnail. The Phantom Springssnail is a freshwater snail that inhabits hard substrates of artesian springs. Currently, the species is only known to exist in a small pool near the mouth of Phantom Cave near Balmorhea, Texas. The primary threat to this species is loss or alteration of spring habitat due to excessive groundwater extraction for agriculture and other purposes. Water quality degradation also poses a threat due to herbicide and pesticide use in agricultural areas that are in close proximity (USFWS, 2015bk). In 2013, the Phantom springsnail was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat consists of the flowing waters of Phantom Lake spring and a small portion of the Phantom lake Canal in Jeff Davis and Reeves Counties, Texas (USFWS, 2013f).

Phantom Tryonia. The Phantom tryonia is a medium-sized freshwater snail with a conical shell and is very similar to the Phantom springsnail. The species inhabits hard and soft substrates in the margins of spring flows. The snail is only known to exist in a handful of springs in Jeff Davis and Reeves Counties, Texas. It is believed the species has a lifespan of 9 to 15 months, although little else is knows about the ecology of the Phantom tryonia. The primary threat to this species is loss or alteration of spring habitat due to excessive groundwater extraction for agriculture and other purposes. In 2013 the Phantom tryonia was officially designated as endangered and critical habitat was designated (78 FR 41227 41258, July 9, 2013). Critical habitat consists of the flowing waters of Phantom Lake spring and a small portion of the Phantom lake Canal in Jeff Davis and Reeves Counties, Texas (USFWS, 2013f).

Robber Baron Cave Meshweaver. The Robber Baron Cave meshweaver is a small essentially eyeless cave spider. This species of meshweaver is only known to exist in Robber Baron Cave in Bexar County, Texas. Like other Bexar County invertebrates, the Robber Baron Cave meshweaver prefers to inhabit caverns with a constant temperature and high humidity. Little is currently known about the life history or ecology of the species. The primary threat to the species is habitat loss from urbanization (USFWS, 2015bl). The Robber Baron Cave meshweaver has been federally listed since 2000 (65 FR 81419 81433, December 6, 2000)

(USFWS, 2000). Critical habitat for the species was designated in Bexar County, Texas in 2012 (77 FR 8450 8523, February 14, 2012) (USFWS, 2012b).

Tooth Cave Ground Beetle. The Tooth Cave ground beetle is a reddish brown beetle endemic to cave systems of Texas. The species is only known to exist in isolated caves of the Edward's Limestone Formation. The beetle prefers to inhabit deep uncompacted silts within the cave system. Little is currently known about the life history or ecology of the species. Currently the Tooth Cave ground beetle is only known to occur in 27 locations in Travis and Williamson Counties, Texas. The primary threat to the Tooth Cave ground beetle is habitat loss or alteration due to commercial or residential development. The Tooth Cave ground beetle has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a). To date, no critical habitat has been designated for this species (USFWS, 2016k).

Tooth Cave Spider. The Tooth Cave spider is a very small pale-colored spider with. The species only occurs in Tooth Cave in Travis County, Texas. The cave is within the Edwards Limestone Formation. Little is currently known about the life history or ecology of the species. The primary threat to the Tooth Cave spider is habitat loss or alteration due to commercial or residential development (USFWS, 2015bm). The Tooth Cave spider has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a). To date, no critical habitat has been designated for this species (USFWS, 2015bm).

Tooth Cave Pseudoscorpion. The Tooth Cave pseudoscorpion is a very small tailless scorpion that exists in only two dry caves in the Edwards Limestone Formation. Currently, the species is only known to occur in Tooth and Amber Caves located in Travis County, Texas where it is typically observed on the undersides of rocks. Little is currently known about the life history or ecology of the species. The primary threat to the Tooth Cave pseudoscorpion is habitat loss or alteration due to commercial or residential development. The Tooth Cave pseudoscorpion has been listed as endangered since 1988 (53 FR 36029 36033, September 16, 1988) (USFWS, 1988a). To date, no critical habitat has been designated for this species (USFWS, 2016l).

Plants

There are 23 endangered and seven threatened plant species federally listed in Texas as summarized in Table 15.1.6-10 (USFWS, 2016a). Two candidate plant species are present in Texas, the Guadalupe fescue (*Festuca ligulata*), and Bracted twistflower (*Streptanthus bracteatus*) (USFWS, 2016b). These species occur in isolated locations throughout Texas. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Texas is provided below.

Table 15.1.6-10: Federally Listed Plant Species of Texas

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Ashy Dogweed	*Thymophylla tephroleuca*	Endangered	No	Sand or sandy loam in grassland or sparse shrubland.
Black Lace Cactus	*Echinocereus reichenbachii var. albertii*	Endangered	No	Mesquite scrub on slightly saline sandy loam.
Bunched Cory Cactus	*Coryphantha ramillosa*	Threatened	No	In creosote-lechuguilla desert scrub on limestone outcrops or "rocky well-drained, full sunlit sites on steep canyon sides and hill summits".
Chisos Mountain Hedgehog Cactus	*Echinocereus chisoensis var. chisoensis*	Threatened	No	Alluvial flats and desert pavement in creosote-lechuguilla Chihuahan desert scrub.
Davis' Green Pitaya	*Echinocereus viridiflorus var. davisii*	Endangered	No	In mixed Chihuahuan desert scrub of creosote and mesquite or semi-desert grassland with sparsely vegetated knife-edged noviculite outcrops and ridges.
Hinckley Oak	*Quercus hinckleyi*	Threatened	No	Dry limestone slopes sotol-lechuguilla Chihuahuan desert scrub.
Large-fruited Sand-verbena	*Abronia macrocarpa*	Endangered	No	On acidic, relatively infertile" sandy soils in open areas in post oak savanna or woodlands.
Little Aguja Creek Pondweed	*Potamogeton clystocarpus*	Endangered	No	Alluvial substrates in shallow, relatively protected, mostly ponded areas.
Lloyd's Mariposa Cactus	*Echinomastus mariposensis*	Threatened	No	In full sun on hills and mesas with alkaline rocky soils derived from light-colored decomposing limestone, in lechuguilla desert scrub.
Navasota Ladies'-tresses	*Spiranthes parksii*	Endangered	No	Along drainages and ephemeral seeps with sandy soils in openings and small clearings within post oak savanna.
Neches River Rose-mallow	*Hibiscus dasycalyx*	Threatened	Yes	In open, seasonally wet or inundated floodplains and bottomlands on clay to loam soils often with a high water table, and are associated with sloughs, oxbows, stream terraces, and other wetlands.
Nellie Cory Cactus	*Coryphantha minima*	Endangered	No	In mixed Chihuahuan desert scrub of creosote and mesquite or semi-desert grassland with sparsely vegetated knife-edged noviculite outcrops and ridges.
Pecos Sunflower	*Helianthus paradoxus*	Threatened	Yes	In open saline or alkaline grassy wetland habitats around desert springs, seeps, wet meadows (cienegas), stream courses and pond margins, in sub-irrigated areas where the lower root zone is saturated by groundwater.
Slender Rush-pea	*Hoffmannseggia tenella*	Endangered	No	Native shortgrass prairie or prairie remnants on clay loam soils.

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
Sneed Pincushion Cactus	*Coryphantha sneedii var. sneedii*	Endangered	No	Semi-desert grassland and is restricted cracks and crevices in limestone cliffs and ledges.
South Texas Ambrosia	*Ambrosia cheiranthifolia*	Endangered	No	Native shortgrass coastal prairie and mesquite savanna on clay loam or sandy loam soils.
Star Cactus	*Astrophytum asterias*	Endangered	No	On very dry sparsely vegetated upland grasslands and open thornscrub on gravelly clays or loams with high levels of gypsum, salts or other alkaline minerals.
Terlingua Creek Cat's-eye	*Cryptantha crassipes*	Endangered	No	Bare, arid badlands in low hills and slopes composed of "small platelets of silty limestone" with a high level of gypsum.
Texas Ayenia	*Ayenia limitaris*	Endangered	No	In partial shade of shrub savannas or the edges of dense thickets of Texas ebony-anacua or Texas ebony-snake-eyes woodlands on well-drained heavy clay soils to fine sandy loams.
Texas Golden Gladecress	*Leavenworthia texana*	Endangered	Yes	Open, sunny glade habitats dominated by herb species on ironstone outcrops with "shallow, calcium-rich soils that are wet in winter and spring".
Texas Poppy-mallow	*Callirhoe scabriuscula*	Endangered	No	Deep alluvial sands in grassland or open oak or mesquite woodlands.
Texas Prairie Dawn-flower	*Hymenoxys texana*	Endangered	No	"Sparsely vegetated areas of fine, sandy and compact soils," often associated with the lower sloping parts of pimple (mima) mounds or barren slicks.
Texas Snowbells	*Styrax texanus*	Endangered	No	Cracks and crevices of limestone cliffs and bluffs along streams and creek beds and associated gravel beds or ledges.
Texas Trailing Phlox	*Phlox nivalis* ssp. *Texensis*	Endangered	No	Deep sandy soils of open pine woodlands, usually with moderate canopy cover and a light understory.
Texas Wild-Rice	*Zizania texana*	Endangered	Yes	Rooted in sand and gravel derived from limestone in fast flowing water.
No common name (Tinytim)	*Geocarpon minimum*	Threatened	No	On the mossy edge of seasonally moist areas with sparse vegetation ("slick spots") and thin soils that have high concentrations of magnesium and sodium.
Tobusch Fishhook Cactus	*Sclerocactus brevihamatus* ssp. *Tobuschii*	Endangered	No	Uplands or near streams on the higher stream bank in open, grassy woodlands or savannas with Ashe juniper, live oak or other woody trees and shrubs on shallow, moderately alkaline rocky or gravelly loams or clays derived from limestone.
Walker's Manioc	*Manihot walkerae*	Endangered	No	Short native grasslands and the understory in open shrublands on relatively thin sandy loam soils associated with caliche.

Common Name	Scientific Name	Federal Status	Critical Habitat in Texas	Habitat Description
White Bladderpod	*Lesquerella pallida*	Endangered	No	Open areas or the margins of thickets or glades with rock outcrops that produce limited areas of alkaline soils; soils are often saturated in winter and spring, but dry and harden in summer.
Zapata Bladderpod	*Lesquerella thamnophila*	Endangered	Yes	On gravelly to sandy loam soils with a high gypsum or calcium carbonate content in open, relatively sparsely vegetated upland shrub communities dominated by cenizo that grade into thornscrub with blackbrush acacia or guajillo.

Sources: (USFWS, 2016b) (USFWS, 2016a) (USFWS, 2015c)

Ashy Dogweed. Ashy dogweed or ashy pricklyleaf is a woody-based densely wooly and glandular perennial herb of the sunflower family that grows to about a foot tall and has a pungent odor when crushed. The dense, wooly hairs on the plant give it an ashy-white appearance. Leaves are alternate and linear, to a half-inch long. Flowering heads are relatively small, with the cup-like involucre only about a quarter inch high and across and containing 10-15 golden yellow ray florets and 30-70 yellow disk florets; flowering heads are up to an inch in diameter (USFWS, 1988b).

The species was listed as endangered in 1984 (49 FR 29232 29234, July 19, 1984). No critical habitat has been proposed for it as of 2015. It is endemic to Texas and only known from Webb and Zapata Counties, and historically from adjacent Starr County, along the Lower Rio Grande (USFWS, 2016m).

Ashy dogweed is found in grasslands or sparse shrublands with level or gently rolling topography, typically on sand or sandy loam soils. Habitat loss, habitat fragmentation, alteration of habitat, invasion by non-native grasses, and climate change (e.g., extended or more frequent drought) threaten the species (USFWS, 2011).

Black Lace Cactus. Black lace cactus is a small (3 to 6 inches) columnar cactus that often occurs in groups of 5 to 12 stems. Stems have 12 to 18 ribs, with short, white spines with dark purple tips radiating from areoles along the ribs. The showy flowers are pink. The fleshy fruit is green with pinkish tones, and is usually less than a half inch long with very short spines radiating from wooly areoles.

The variety was listed as endangered in 1979 (44 FR 61918 61920, October 26, 1979), but no critical habitat has been proposed. It is known from three geographically distinct populations on the coastal plain in southern Texas, in Jim Wells, Kleburg and Refugio Counties (USFWS, 1987a).

Habitat for black lace cactus can be characterized as mesquite (*Prosopis glandulosa*) scrub on slightly saline sandy loams, and is often along stream courses. The region where the species occurs is recognized as a transition area between coastal grasslands and Rio Grande plain shrub communities. Plants grow in natural openings or under open shade beneath low, protecting shrubs or prickly pear (*Opuntia* spp.). Habitat alteration and disturbance, primarily brush clearing for range improvement or conversion to cropland, is the major threat to this variety (USFWS, 1987a). Invasion by non-native grasses or other non-native species, habitat alteration due to climate change, cattle grazing (trampling of plants in open areas), rooting by feral hogs, and zealous collecting of cacti by private or commercial entities are also threats to this species (USFWS, 1987a) (USFWS, 2009b).

Bunched Cory Cactus. The bunched cory cactus is a small, globe-shaped (2 to 4 inches in diameter) cactus, which due to being seated deeply in the ground often appears hemispheric or flat-topped. Stems are most often unbranched, but rarely can form groups of up to 25 stems. The spines radiate from areoles at the tip of nipple-like tubercles, and are up to an inch long and white or grayish white, though central spines may be a dark brown. Flowers are up to 2 inches in diameter, and are pale pink to deep rose-purple. Bloom time is August to November. Fruits are a fleshy egg-shaped berry, usually dark green or pale gray-green, and up to an inch long and about half as wide (eFloras, 2015).

The species was listed as threatened in 1979 (44 FR 64247 64250, November 6, 1979), and no critical habitat has been proposed. It is a regional endemic in the Big Bend area of west Texas, and is known from Brewster and Terrell Counties and the adjacent state of Coahuila, Mexico (USFWS, 1989a).

Bunched cory cactus occurs in Chihuahan desert scrub dominated by creosote (*Larrea tridentata*) and lechuguilla (*Agave lechuguilla*), and is found as individuals or scattered populations on limestone outcrops or "rocky well-drained, full sunlit sites on steep canyon sides and hill summits" (USFWS, 1989a). The low population numbers of this species make it vulnerable to collecting, off-road vehicles, and trampling by livestock (USFWS, 1989a).

Chisos Mountain Hedgehog Cactus. Chisos Mountain hedgehog cactus is a small (10 to 12 inches) columnar cactus that usually is found as a single stem, though it can occur small groupings. Stems have 10 to 16 vertical or somewhat spirally arranged ribs. Spines radiate from areoles arranged along the length of the ribs. Spines can vary in length up to about an inch though most are generally less than a half inch long, and are white or grayish with dark brown, maroon or black tips. Blooms appear from March to July, and are pink to magenta or dark crimson. Fruits are narrowly club-shaped and up to an inch long, greenish-red to red, with wooly areoles and short bristles (USFWS, 1993a).

The variety was listed as threatened in 1988 (53 FR 38453 38456, September 30, 1988), and no critical habitat has been proposed. It is endemic to the Big Bend region of west Texas, and is only found in Brewster County. (USFWS, 2016n)

Chisos Mountain hedgehog cactus is found on alluvial flats and desert pavement in Chihuahan desert scrub dominated by creosote (*Larrea tridentata*) and lechuguilla (*Agave lechuguilla*) or other desert shrubs. It is almost always found growing under the shelter of a nurse plant (USFWS, 1993a). The low population numbers of this species make it vulnerable to collecting, and it is threatened by expansion and maintenance of existing facilities at Big Bend National Park, mammal predation, and habitat alteration due to climate change (USFWS, 1993a).

Davis' Green Pitaya. Davis' green pitaya is a very small (0.4 to 1.5 inches tall), egg-shaped to globose cactus that is usually found as a single stem, often nestled within rock crevices or among club-mosses (*Selaginella peruviana*) (USFWS, 1984a) (USFWS, 2012c). During drought, stems may shrink until well hidden and obscure. Each stem has 6 to 10 ribs, lined with areoles from which radiate 8 to 15 grayish spines, which may be red-tipped. Flowers are yellow-green, faintly lemon-scented, and bloom between March and April. Fruit is set about a month after flowering, and is a small reddish-green to purplish brown oval berry less than a half inch long (USFWS, 2012c).

The variety was listed as endangered on 1979 (44 FR 64738 64740, November 7, 1979), and no critical habitat has been designated (USFWS, 2015bn). It is a narrow endemic found only in northern Brewster County in the Big Bend region of west Texas (USFWS, 2015bn).

Davis' green pitaya grows only on "chips and physically fractured" rock of a particular rock type called noviculite, which, as found in west Texas, occurs in sparsely vegetated knife-edged outcrops and ridges in mixed Chihuahuan desert scrub of creosote (*Larrea tridentata*) and mesquite (*Prosopis glandulosa*) or semi-desert grassland (USFWS, 1984a) (USFWS, 2012c). The low population numbers of this variety make it vulnerable to illicit collecting, and extended drought associated with climate change is a major threat (USFWS, 2012c). Interspecific competition for the limited space and resources of this specialized habitat, herbivory by rodents and insects, and potential trampling by livestock are minor threats (USFWS, 1984a).

Hinckley Oak. Hinckley oak or chaporro is a low (commonly to 2.5 feet, but up to 4 feet) shrubby evergreen oak with holly like leaves. It can grow as a single-stemmed small shrub, but more often grows in dense clonal thickets, with each individual producing multiple stems. Leaves are on short stems, and are small, gray-green, broadly oval, and leathery, with spines on the wavy edges that resemble those on hollies. Flowers are small and nondescript, and the fruit is a small acorn to about a half-inch wide and three-quarters of an inch long, with a shallow (0.1 inch) cup (USFWS, 1992a).

The species was listed as threatened 1988 (53 FR 32824 32827, August 26, 1988) but no critical habitat was proposed (USFWS, 2015bo). The species is found in Brewster and Presidio Counties of the Big Bend region of west Texas (USFWS, 2015bo).

Hinckley oak occurs on dry limestone slopes at 3,500 to 4,500 feet in Chihuahuan desert scrub dominated by sotol (*Dasylirion leiophyllum*) and lechuguilla (*Agave lechuguilla*) (USFWS, 2009c). It is threatened by low population numbers, hybridization with other oak species, roadway construction and maintenance, horticultural collection, herbivory by wildlife, livestock and insects (USFWS, 1992a), and habitat alteration due to climate change (USFWS, 2009c).

Large-fruited Sand-verbena. Large-fruited sand-verbena is a tap-rooted perennial herb in the four-o'clock family (USFWS, 1992b) (USFWS, 2010c). It grows to about 20 inches tall, and may be somewhat spreading. Leaves and stems are "sticky from glandular hairs." Leaves are on short stems and are egg-shaped, about three-quarters of an inch to two inches long, and almost as wide. Flowers are bunched in quite showy heads of 20 to 75 individual magenta flowers. Each flower has a long tube up to an inch or more long that widens into five lobes, and is about a half-inch across at the top. Flowers open in the late afternoon until mid- morning, and have a sweet, honeysuckle-like smell (USFWS, 2010c). Bloom time is usually March to May, though they can bloom after fall rains, too. Fruit is mature about a month after pollination, and is up to a half-inch long with five papery, twisted wings and a single seed (USFWS, 1992b).

The species was listed as endangered in 1988 (53 FR 37975 37978, September 28, 1988), and no critical habitat was designated (USFWS, 2015bp). It is a central Texas endemic and is found in Freestone, Leon, and Robertson Counties (USFWS, 2015bp).

Large-fruited sand-verbena is found on "acidic, relatively infertile" sandy soils in post oak (*Quercus stellata*) savanna or woodlands (USFWS, 2010c). It occurs in open or disturbed areas with only scattered trees and shrubs and no or very sparse vegetative cover of grasses or other herbs, often along drainages (USFWS, 1992b). The species is threatened by commercial and residential development, oil and gas exploration and development, fire suppression, range improvements, grazing, off-highway vehicles, and introduction of non-native species (USFWS, 1992b) (USFWS, 2010c).

Little Aguja Creek Pondweed. Little Aguja pondweed is a submerged aquatic plant in the pondweed family. Stems are light green to brown, and very thin, only 1/32 of an inch wide, and vary in length depending on depth of water. Leaves are spirally arranged and alternating along the stem, and are green and linear, up to 3 inches long but only 1/16 of an inch wide, with a pointed tip. Small narrow bracts are found at the base of the leaf. Flowers are borne at the terminal end of the stem or on stalks rising out of the leaf axils, usually in three groups. Flowering stalks can be up to two inches long, and are the only portion of the plant that grows above water. Flowers are small, about 0.15 inch wide. Fruiting stalks are retracted below the water surface. Fruit is a four-parted and berry like, brown to yellowish, with each portion about 0.1 inches wide (USFWS, 1994a).

The species was listed as endangered in 1991 (56 FR 57844 57849, November 14, 1991), and no critical habitat was designated (USFWS, 2015bq). It is endemic to Little Aguja Creek in the Davis Mountains of Jeff Davis County in west Texas (USFWS, 1994a).

Little Aguja pondweed is known from a single location on Little Aguja Creek growing in alluvial substrates in shallow, relatively protected, mostly ponded areas; the creek has a steep rocky bed and does not flow continuously along its course through parts of the year (USFWS, 1994a). It is threatened by periodic droughts and scouring floods (and thus the effects of climate change are a threat as well), potential habitat modifications (*e.g.,* dam-building or diversion), and changes in land use (USFWS, 1994a).

Lloyd's Mariposa Cactus. Lloyd's Mariposa cactus is a small, egg-shaped to cylindrical cactus, with a single stem up to about 4 inches tall and half as wide (USFWS, 1989b). Stems have typically 21 ribs, but these may be so deeply divided between the spine-bearing areoles as to appear covered by nipple-like tubercles. Short, pale tan or grayish-white spines radiate from the areoles with the largest often somewhat blue-gray or brown on the tips, and ranging in number from 23 to 30. Flowers are white or tinged with pink and about 1.2 inches wide. Bloom time is

February to March. The fruit is a fleshy club-shaped or spheric berry about a half inch long (USFWS, 1989b).

The species was listed as threatened in 1979 (44 FR 64247 64250, November 6, 1979), and no critical habitat was designated (USFWS, 2015br). It is known from Presidio and Brewster Counties of the Big Bend region of west Texas and the Mexican state of Coahuila (USFWS, 1989b).

Lloyd's Mariposa cactus is found growing in full sun on hills and mesas with alkaline rocky soils derived from light-colored decomposing limestone (USFWS, 2015br). The habitat is open with few shrubs, and can be characterized as Chihuahuan desert scrub dominated by lechuguilla (*Agave lechuguilla*). Threats to the species include mining, oil and gas exploration and development, off-highway vehicle use, trampling by livestock, and primarily private and commercial collecting (USFWS, 1989b).

Navasota Ladies'-tresses. Navasota ladies'-tresses is a perennial herb in the orchid family (USFWS, 1984b). The species was listed as endangered in 1982 (47 FR 19539 19542, May 6, 1982) and no critical habitat has been proposed. It is known to occur in 13 counties in eastern central Texas (USFWS, 2015bs). It is an inconspicuous, slender, upright plant with a single stem to about a foot tall. Leaves are mostly at the base of the stem and are linear, but usually are not present when the plant is flowering. The small, cream-colored flowers are arranged spirally at the top of stem, and are attached directly to the stem, with each flower more or less surrounded by a single, white-tipped bract. Flowers consist of three petals, with the lower somewhat larger than the two lateral petals (USFWS, 1984b). Bloom time is late October to November (USFWS, 2009d).

Navasota ladies'-tresses is found along drainages and ephemeral seeps with sandy soils in openings and small clearings within post oak (*Quercus stellata*) savanna (USFWS, 1984b) (USFWS, 2009d). It is primarily threatened by habitat loss due to road, commercial and residential development, oil and gas exploration and development, and mining, as well management practices that increase density of woody understory plants (*e.g.,* fire suppression) (USFWS, 1984b) (USFWS, 2009d). A minor threat is individual or commercial collection (USFWS, 1984b).

Neches River Rose-mallow. Neches River rose-mallow is a large perennial herb in the mallow family. It is almost shrubby, but is not at all woody. Stems grow to three or four feet tall, but rarely up to seven feet, and spread two to three feet wide. Leaves are borne alternately on short stalks along the stem, and are very narrow with three deep lobes. The large and showy bowl-shaped flowers (3 to 6 inches across) arise from the upper leaf axils or branches, and have 5 white (or sometimes pinkish) petals with a burgundy colored center, with the large and showy stamens fused by their stalks into a central column. Bloom time is June to August, though with favorable conditions, this can extend through October. The fruit is a multi-parted, pie-like structure. After fruiting, the plant dies back to the root and re-sprouts the following spring (77 FR 55967 56026, 11 September 2012).

Neches River rose-mallow was listed as threatened in 2013 (78 FR 56025 56069, September 11, 2013) with critical habitat designated (78 FR 56071 56120, September 11, 2013). It is known from Cherokee, Houston, and Trinity Counties in the Pineywoods region of east Texas, with critical habitat designated in those three counties as well as Harrison and Nacogdoches Counties (USFWS, 2015bt)

The species is found in open, seasonally wet or inundated floodplains and bottomlands on clay to loam soils often with a high water table, and are associated with sloughs, oxbows, stream terraces, and other wetlands (77 FR 55967 56026, September 11, 2012). It is threatened by habitat loss due to encroachment by non-native species and native, woody species (e.g., conversion of open bottomlands to woody savanna or forest), by agricultural herbicide use, trampling and herbivory by livestock and feral hogs, alteration of natural hydrology (e.g., flood control, wetland draining, reservoir or pond construction), and habitat alteration due to climate change (e.g., extended or frequent drought) (77 FR 55967 56026, September 11, 2012).

Nellie Cory Cactus. Nellie Cory cactus is a very small (0.4 to 1.6 inches) egg-shaped to shortly cylindrical cactus, usually with a single stem (USFWS, 1984c), though in cultivation it often forms dense branching clusters (USFWS, 2012c). About 15-27 ashy-gray to pinkish spines radiate from areoles at the tip of nipple-like tubercles, obscuring the stem. Flowers are up to an inch in diameter, and are pale pink to reddish rose-purple. Bloom time is April to May, with fruits maturing about a month later. Fruits are an egg-shaped berry, usually green to yellowish, and up to a quarter-inch long (USFWS, 2012c). The species was listed as endangered on 1979 (44 FR 64738 64740, November 7, 1979), and no critical habitat has been designated (USFWS, 2015bu). It is a narrow endemic found only in northern Brewster County in the Big Bend region of west Texas (USFWS, 2015bu).

Nellie cory cactus grows only on “chips and physically fractured” rock of a particular rock type called noviculite, which, as found in west Texas, occurs in sparsely vegetated knife-edged outcrops and ridges in mixed Chihuahuan desert scrub dominated by creosote (*Larrea tridentata*) and mesquite (*Prosopis glandulosa*) or semi-desert grassland (USFWS, 2012c). It is often associated with a club-moss (*Selaginella peruviana*). The low population numbers of this species make it vulnerable to illicit collecting, and extended drought associated with climate change is a major threat (USFWS, 2012c). Interspecific competition for the limited space and resources of this specialized habitat, herbivory by rodents and insects, and potential trampling by livestock are minor threats (USFWS, 1984c).

Pecos Sunflower. Pecos sunflower is an annual herb in the sunflower family. Stems stand between 3-10 feet tall, and branch at the top, and like the leaves, are covered in short stiff hairs. Leaves are opposite on the lower stem, but alternate nearing the top. Leaves are lance-shaped, with 3 prominent veins, and are up 7 inches long and 3 inches wide. Flowering heads are two to three inches across, with bright yellow ray florets (the petals) surrounding a dark purplish center (the disc florets). Bloom time is September to October. The fruit is a small sunflower seed (USFWS, 2005c).

Pecos sunflower was listed as threatened in 1999 (64 FR 56582 56590, October 20, 1999) and critical habitat was designated in 2008 (73 FR 17762 17807, April 1, 2008). In Texas, it distribution is limited to Pecos and Reeves Counties of west Texas, but is known from adjacent southeast New Mexico as well (USFWS, 2015bv). Critical habitat was designated in Chaves, Cibola, and Guadalupe Counties in New Mexico and in Pecos County, Texas (73 FR 17762 17807, April 1, 2008).

The species occurs in open saline or alkaline grassy wetland habitats around desert springs, seeps, wet meadows (also known as cienegas), stream courses and pond margins, in sub-irrigated areas where the lower root zone is saturated by groundwater (USFWS, 2005c) (USFWS, 2015bw). Threats to the species include groundwater depletion, changes in land use (e.g., conversion to agriculture either as crop or rangeland), oil and gas exploration and development, encroachment by non-native species (e.g., salt-cedar [*Tamarix* sp.] and Russian olive [*Elaeagnus angustifolia*]), and habitat alteration due to climate change (USFWS, 2005c) (USFWS, 2015bw)

Slender Rush-pea. Slender rush-pea is a spreading perennial herb in the pea family. Stems grow from a long, woody taproot, and can be up to 6 inches long, spreading along the ground. Leaves are bipinnately compound and up to about 6 inches long, with tiny, narrow leaflets only up 1/8 of inch long. Stems terminate with 3 to 5 small orange pea-type flowers less than a ¼ inch long. Bloom time is March to June. The fruit is a small narrow bean pod only about a ½ inch long containing 2 to 4 seeds (USFWS, 1988c).

Slender rush-pea was listed as endangered in 1985 (50 FR 45614 45618, November 1, 1985) but no critical habitat has been proposed (USFWS, 2015bx). It is known from Kleburg and Nueces Counties of the coastal bend of south Texas (USFWS, 2015bx).

The species is found in native shortgrass prairie or prairie remnants on clay loam soils (USFWS, 1988c). It is vulnerable due to low population numbers and limited distribution. Threats to species include continued conversion of native gulf coastal prairie to cropland or pasture which have historically reduced the distribution of the species, range improvement with introduction of non-native grasses, increased cover by native and non-native woody species, and road and utility development and maintenance (USFWS, 2008b).

Sneed Pincushion Cactus. Sneed pincushion cactus is a small, many branched clumped cactus, often with “up to 100 or more” stems (USFWS, 1986). Individual stems can be spherical to cylindrical or club-shaped, from 1 to 3 inches tall and up to slightly over an inch wide. About 40 to over 100 white spines (sometimes tipped with pink and brown) radiate from areoles at the tip of nipple-like tubercles, obscuring the stem. Flowers are up to a half inch in diameter, and are pale to rose magenta. Bloom time is March to April, with fruits maturing from about August to November; it may also bloom after summer rains in July and August. Fruits are a usually grayish-green or brown-tinged green, club-shaped berry and up to a quarter-inch long. When ripe they have a “prune-like odor” may sometimes be slightly pinkish (USFWS, 1986).

This variety was listed as endangered in 1979 (44 FR 64741 64743, November 7, 1979) but no critical habitat has been proposed (USFWS, 2015by). In Texas, it is limited to El Paso County in far west Texas, but is also known from adjacent Dona Ana and Eddy Counties, New Mexico (USFWS, 2015by).

Sneed pincushion cactus grows in semi-desert grassland and is restricted cracks and crevices in limestone cliffs and ledges (USFWS, 1986). The primary threat is that the small population sizes and limited distribution make this species vulnerable to commercial or individual collecting (USFWS, 1986), although this pressure was more recently perceived to be less of a threat (USFWS, 2015bz). Habitat loss to residential and commercial development, trampling by wildlife and livestock, fire, and habitat alteration due climate change are also threats (USFWS, 2015bz).

South Texas Ambrosia. South Texas ambrosia is an erect perennial herb in the sunflower family. It grows from about 4 inches to a foot tall, and can form large clonal colonies that spread by underground stems called rhizomes. Leaves are a silvery or grayish green due to a dense covering of long silky hairs. Leaves are opposite at the bottom of the stem, but become alternate toward the top. They are attached directly to the stem, and are elliptical, about three inches long and half as wide. Small heads with 10 to 20 tiny yellow female flowers are clustered in upper leaf axils. Above this, the top 2 to 4 inches of the elongated stem is leafless but with stalked, inverted bowl-shaped heads with male flowers. Bloom time is July to November. The fruit is a bur (USFWS, 2008c) (USFWS, 2015ca).

It was listed as endangered in 1994 (59 FR 43648 43652, August 24, 1994) and no critical habitat has been proposed (USFWS, 2015ca). It is known from Cameron, Jim Wells, Kleburg and Nueces Counties of coastal south Texas and historically from the state of Tamualipas, Mexico (USFWS, 2008c).

South Texas ambrosia inhabits native shortgrass coastal prairie and mesquite (*Prosopis glandulosa*) savanna on clay loam or sandy loam soils. Threats to the species include habitat loss, alteration and fragmentation through conversion of native plant communities to commercial or agricultural (crop or pasture) uses, displacement by invasive nonnative grasses and encroachment by woody trees and shrubs, residential and commercial development, and road and utility construction and maintenance, and alteration of the habitat due to climate change. Low population numbers (and consequently, low genetic diversity) and limited distribution are also a threat (USFWS, 2008c).

Star Cactus. Star cactus is a low growing, spineless cactus. The disk or dome-shaped stem usually just crowns the surface; stems are up to 3 inches tall, but are mostly below ground. It is a dull green, which turns brownish under dry conditions, and is divided into 8 irregularly pie-shaped sections. It reaches up to 6 inches in diameter. Small tufts of short white wooly hairs appear irregularly across the surface near the top of the stem, and more commonly along the divide between sections. Flowers can be up to 6 inches in diameter, and are yellow with orange centers. Bloom time is typically March to May, with fruits appearing about a month later, but it may follow rainfall. Fruits are a fleshy green to reddish berry covered with wooly hairs, to about a half inch long (USFWS, 2003b).

It was listed as endangered in 1993 (58 FR 53804 53807, October 18, 1993) and no critical habitat has been proposed (USFWS, 2015cb). The species is found in the Lower Rio Grande Valley in Hidalgo and Starr Counties of south Texas and in the states of Coahuila, Tamaulipas and Nuevo Leon, Mexico (USFWS, 2015cb).

Star cactus grows in very dry sparsely vegetated upland grasslands and open Tamaulipan thornscrub on gravelly clays or loams with high levels of gypsum, salts or other alkaline minerals (USFWS, 2003b) (USFWS, 2015cb) (USFWS, 2015cc). Threats to the species include habitat loss and modification due to conversion to agriculture, road and utility construction, oil and gas exploration and development, residential and commercial development, range management or agricultural practices (e.g., plowing, introduction of non-native grasses, herbicides, overgrazing, fire suppression), and collection by individuals and for the commercial cactus trade (USFWS, 2003b) (USFWS, 2015cc). Habitat alteration due to climate change is also a potential threat (USFWS, 2015cc).

Terlingua Creek Cat's-eye. Terlingua Creek cat's-eye is a perennial herb in the borage family. The plant is densely hairy with short white bristles on the stem and leaves, and appears silvery. Stems are generally erect, unbranched, and range from 6 to 10 inches tall. A "dense mound" of leaves up to a foot in diameter forms above the woody base, with largest, lowest leaves being up to about 2.5 inches long and a quarter inch wide. The leaves are generally lance-shaped with acute tips, and become progressively smaller up the stem. Flowers are in inch-wide clusters at the end of stem. Each flower has a cylindrical tube about a quarter inch long that expands into a flat, five-lobed face less than a quarter inch across and a "knobby, bright yellow center." Bloom time is late March to early June. The fruit consists of four small gray egg-shaped nutlets only about 0.1 inch long each (USFWS, 1994b).

It was listed as endangered in 1991 (56 FR 49634 49636, September 30, 1991) and no critical habitat has been proposed (USFWS, 2015cd). It is known only from the upper Terlingua Creek drainage in Brewster County of the Big Bend region of west Texas (USFWS, 1994b).

The Terlingua Creek cat's-eye grows on bare, arid badlands in low hills and slopes composed of "small platelets of silty limestone" with a high level of gypsum; it is an endemic to a particular geologic formation with limited distribution (USFWS, 1994b). Threats to the species include off-highway vehicle use, recreational biking and hiking, horseback riding, and habitat loss due to residential and commercial development, and road and utility construction and maintenance (USFWS, 1994b).

Texas Ayenia. Texas ayenia or Tamaulipan kidneypetal is a small shrub in the chocolate family. It ranges from one to six feet tall and up to 10 feet wide. The reddish-brown older stems are speckled with small white dots (called lenticels) and up to almost an inch in diameter. The heart-shaped leaves are alternate along the stem, and about three inches long and half as wide. They are finely toothed along the edges and densely covered on the underside with fine, star-shaped hairs. Flowers grow on short branched stalks out of the upper leaf axils, with up to four sets of two or three flowers at each leaf. Flower color varies from green, pink or cream. Flowers have five kidney-shaped petals and are about a quarter inch wide. Bloom time generally follows significant rainfall, most commonly from April to May and September to November. The fruit is a 5-seeded capsule, densely covered in hooked “velcro-like” hairs. (USFWS, 2014h) (USFWS, 2015ce).

It was listed as endangered in 1994 (59 FR 43648 43652, August 24, 1994) and no critical habitat has been proposed (USFWS, 2015ce). The species is known from the Lower Rio Grande Valley in Cameron, Hidalgo and Willacy Counties of extreme southern Texas and the state of Tamaulipas, Mexico. Historically, it was potentially known from the states of Coahuila and Durango, Mexico, as well (USFWS, 2014h).

Texas ayenia grows in partial shade of shrub savannas or the edges of dense thickets of Texas ebony-anacua (*Pithecellobium (Chloroleucon, Ebanopsis) ebano – Ehretia anacua*) or Texas ebony-snake-eyes (*Phaulothamnus spinescens*) woodland communities on well-drained heavy clay soils to fine sandy loams (USFWS, 2014h). Threats to the species include habitat loss and alteration from agricultural, residential and commercial development, oil and gas exploration and development, herbicide and pesticide use, loss of pollinators and competition with non-native grasses. Given low population numbers, habitat fragmentation can also lead to genetic isolation and population bottlenecks that result in loss of genetic diversity as another long-term threat to the species (USFWS, 2014h).

Texas Golden Gladecress. Texas golden gladecress is a small, annual herb plant in the mustard family. Seeds germinate in late fall or winter, with plants maturing and dying back by late spring and summer. Stems grow only to about four inches high, with leaves only in a rosette at the base of the flowering stem. Individual flowers are on short stalks, and have four, tongue-shaped, bright golden yellow petals. Bloom time is February to March. The fruit a narrow, long capsule ranging from a half inch to just over an inch long, with 5 to 11 seeds (77 FR 55967 56026, September 11, 2012).

Texas golden gladecress was listed as endangered in 2013 (78 FR 56025 56069, September 11, 2013) with critical habitat designated (78 FR 56071 56120, September 112013). It is known from Sabine and San Augustine Counties of the Pineywoods region of east Texas (USFWS, 2015cf).

The species is a narrow endemic that is limited to open, sunny glade habitats dominated by herb species on ironstone outcrops with “shallow, calcium-rich soils that are wet in winter and spring” (77 FR 55967 56026, September 11, 2012). Threats to the species include habitat loss due to commercial or residential development, road and utility construction, mining, oil and gas exploration and development, agricultural conversion of wildlands, encroachment by non-native species and native, woody species (e.g., conversion of open glades to woody savanna or forest), by agricultural herbicide use, trampling and herbivory by livestock and feral hogs, and habitat alteration due to climate change (e.g.*,* extended or frequent drought) (77 FR 55967 56026, September 11, 2012).

Texas Poppy-mallow. Texas poppy-mallow is a perennial herb in the mallow family. Stems are simple or basally branched and erect, growing to 18 inches tall. Stems and leaves are covered with small, star-shaped plant hairs. Leaves alternate along the stem and are radially and deeply 3 to 5 lobed, the upper leaves more deeply so. Flowers are on spirally arranged long stalks at the top of the stem. Flowers are cup-shaped with five deep red to purple petals with a deeper red or dark maroon at the base; a common name for similar species is "wine cup." Bloom time is late April to May. The fruit is a dry many-parted disk (Poole, Carr, Price, & Singhurst, 2008) (USFWS, 1985b).

It was listed as endangered in 1981 (46 FR 3184 3186, January 13, 1981) and no critical habitat has been proposed (USFWS, 2015cg). It is found in the upper Colorado River watershed in the Rolling Plains region of Coke, Mitchell and Runnels Counties of west central Texas (USFWS, 2015cg).

Texas poppy-mallow is found on deep alluvial sands in grassland or open oak or mesquite woodlands. Threats to the species include habitat loss, fragmentation, and alteration due to residential or commercial development (especially sand mining), road and utility construction, livestock grazing, and wildflower collecting (USFWS, 1985b).

Texas Prairie Dawn-flower. Texas prairie dawn-floweris an annual herb in the sunflower family. One to five or more flowering stems rise from one to seven inches tall from a basal rosette of leaves. Each stem can branch two or more times. Stems and leaves are slightly to moderately hairy with scale-like plant hairs, and the leaves have small glands. The slightly fleshy spoon-shaped leaves at the base can be up to 1.5 inches long and about half as wide, with the widest portion being toward the tip and teeth or short lobes on the edges from the middle to the tip. Leaves alternate along the stem, and upper stem leaves are linear and few. Small, bowl-shaped flowering heads terminate the stems and branches, and contain a number of tiny, bright yellow flowers. Bloom time is March through April. The fruit is a small sunflower-like seed (USFWS, 1990b).

It was listed as endangered in 1986 (51 FR 8681 8683, March 13, 1986) and no critical habitat has been proposed (USFWS, 2015ch). It is found in the coastal prairie region of Fort Bend, Harris and Trinity Counties in southeast Texas (USFWS, 2015ch), and was more recently documented in Greg and Waller Counties in east Texas (USFWS, 2015ci).

Texas prairie dawn-flower is found on "sparsely vegetated areas of fine, sandy and compact soils," and are often associated with the lower sloping parts of pimple mounds (sometimes called mima mounds; a sandy dome-like extrusion that is distinct from surrounding fine clay soils) and barren slicks (USFWS, 1990b) (USFWS, 2015ci). Habitat loss and modification due to residential and commercial development, encroachment by woody vegetation, rooting by feral hogs, road and utility construction and maintenance, range management practices, overgrazing, alteration of local hydrology, and agricultural and natural resource development are threats to this species (USFWS, 1990b) (USFWS, 2015ci).

Texas Snowbells. Texas snowbells is a small multi-stemmed deciduous tree or shrub in the storax family. It grows to about 14 feet tall. Leaves alternate along the branches, and are ovate or rounded, 1.5 to 3 inches long, smooth and green above but white below – the underside of the leaf is densely covered with fine, silky hairs. One to five flowers grow on short, branching stalks from the leaf axils at the ends of branches, and hang upside down, like small, white bells. Flowers are about an inch or more across with 5 white petals and 10 golden-orange stamens.

Bloom time is late March to late April. The fruit is a one (or rarely two or three) seeded spherical capsule about a quarter inch in diameter (USFWS, 1987b).

It was listed as endangered in 1984 (49 FR 40036 40038, October 12, 1984) and no critical habitat has been proposed (USFWS, 2015cj). It is native to the southern Edwards Plateau region of central Texas in Edwards, Real and Val Verde Counties (USFWS, 2015cj).

Texas snowbells grows in the cracks and crevices of limestone cliffs and bluffs along streams and creek beds, but can also grow on level ground such as stream gravels and thin soils of limestone ledges (USFWS, 1987b) (USFWS, 2008d). Threats to the species include herbivory by livestock and native or exotic ungulates, habitat alteration by fire suppression, brush clearing, and cultivation, natural flooding and erosion, small population size, and drought stress (USFWS, 1987b) (USFWS, 2008d).

Texas Trailing Phlox. Texas trailing phlox is an evergreen perennial subshrub in the phlox family. Herbaceous stems arise from a woody root, forming spreading clumps. Leaves are densely packed on the stem, appearing needle or scale-like, usually less than a half inch long. Young stems are generally more erect, with longer, slightly lighter green leaves, with 3 to 12 flowers appearing on branches on the end of the longer stems. Flowers are pink to magenta (rarely white), about a half inch long with five petal lobes. Bloom time is March to May (USFWS, 1995).

It was listed as endangered in 1991 (56 FR 49636 49639, September 30, 1991) and no critical habitat has been proposed (USFWS, 2015ck). The subspecies is endemic to Hardin, Polk and Tyler Counties in the Pineywoods of southeast Texas (USFWS, 2015ck).

Texas trailing phlox is found on deep sandy soils of open pine woodlands, usually with moderate canopy cover and a light understory (USFWS, 1995). Threats to the subspecies include habit loss or modification due residential and commercial development, road and utility construction and maintenance, encroachment of woody trees and shrubs due to fire suppression, and conversion of natural lands to pine plantations or other agriculture (USFWS, 1995).

Texas Wild-rice. Texas wild-rice is an aquatic perennial grass. It grows typically from 3 to 6 feet long, but up to 13 feet or more. Leaves are linear between 0.2 to 1 inch wide and up to 4 feet long. In slow water, the flowering part of the stem (as well as upper leaves) becomes emergent. Flowers are borne in a branching structure with female flowers on branches compacted close to the stem and male flowers below on more open, spreading branches. Flowers are generally less than a half inch long and not at all showy. Bloom occurs primarily in spring and fall but can happen throughout the warm season. The fruit is a grain (USFWS, 1996).

It was listed as endangered in 1978 (43 FR 17910 17916, April 26, 1978) with critical habitat being designated in 1980 (45 FR 17888 17891, March 19, 1980). It is endemic to the San Marcos River in Hays County in central Texas (USFWS, 2015cl).

Texas wild-rice grows in large clumps immersed in fast flowing water, rooted in sand and gravel derived from limestone (USFWS, 1996). The species is threatened by groundwater depletion and loss of spring flow, declining water quality (e.g., chemical spills and contamination, changes in pH, changes in trace elements, changes in temperature), habitat modification (e.g., channelization, bank stabilization, flood control, landscape modifications or practices that affect hydrology or runoff, waterway dredging), invasive non-native species (e.g., direct competition with non-native plants such as hydrilla (*Hydrilla verticillata*), herbivory by non-native animals such as the giant ramshorn snail [*Marisa cornuarietis*] or nutria [*Myocaster coypus*]), and the impacts of recreational activities (USFWS, 1996).

Tinytim. Tinytim or earth-fruit is a small annual species that is only easily visible for a few weeks during early spring (USFWS, 2015cm). This diminutive species has opposite, cup-shaped leaves and branches and measures approximately 0.4 to 1.6 inches tall. When young it is dull gray until maturity when it turns a purplish-red color (USFWS, 1993b). Flowers are located in the leaf axil, and are small and greenish-red, lacking petals. Fruit is a small capsule with minute but numerous seed. It was listed as threatened in in 1987 (52 FR 22930 22933, June 16, 1987). This species is known to or believed to occur in Arkansas, Louisiana, Missouri, and Texas. In Texas, this species is known to occur on clay pan soils above the floodplain of the Neches River in three counties of eastern Texas (USFWS, 2015cm), two of which border Louisiana parishes that also support known populations (USFWS, 1993b). As of 2015, no critical habitat has been proposed for this species (USFWS, 2015cm).

Throughout most its range, this species is found on the mossy edge of seasonally moist areas with sparse vegetation ("slick spots") and thin soils that have high concentrations of magnesium and sodium, with the exception of Missouri. In Missouri this species is only found in sandstone glades or outcrops of upland prairies (USFWS, 1993b). Threats to the species include alteration or destruction of its habitat due to climate change, competition with other plant species, and changes in soil due to development (USFWS, 1993b).

Tobusch Fishhook Cactus. Tobusch fishhook cactus is a small spherical to ovoid cactus ranging from two to three inches tall and slightly broader around, typically growing as a single stem. It has 10 to 15 spines radiating from areoles on top of nipple-shaped tubercles; the central spines are often yellowish with red tips when young, and the lower central spine is hooked at the tip, similar to a fishhook. Flowers are yellow to cream-colored, and about an inch and a half in diameter. Bloom time is February to March. The fruit is a green, fleshy berry that ripens to pink or pinkish-brown (USFWS, 1987c).

It was listed as endangered in 1979 (44 FR 64736 64738, November 7, 1979) and no critical habitat has been proposed (USFWS, 2015cn). In the most recent 5-year review by the USFWS, downlisting to threatened status was recommended for the subspecies (USFWS, 2010d). It is known from eight counties on the Edwards Plateau of central Texas (Bandera, Edwards, Kerr, Kimble, Kinney, Real, Uvalde and Val Verde Counties) (USFWS, 2015cn).

Tobusch fishhook cactus grows in open, grassy woodlands or savannas with Ashe juniper (*Juniperus ashei*), live oak (*Quercus fusiformis*) and sycamore (*Platanus occidentalis*) or other woody trees and shrubs on shallow, moderately alkaline rocky or gravelly loams or clays derived from limestone, in uplands or near streams on the higher stream bank (USFWS, 1987c) (USFWS, 2010d). Threats to the species include collection, grazing, and habitat loss and modification due to residential and commercial development, flooding, road and utility construction, management practices and climate change (USFWS, 1987c) (USFWS, 2010d). An undescribed species of parasitic weevil (*Gerstaeckeria* sp.) has also been recognized as a significant cause of mortality in the species (USFWS, 2010d).

Walker's Manioc. Walker's manioc is a perennial herb in the spurge family. All parts of the plant have a strong odor of cyanide when fresh. Roots are swollen and carrot-shaped with a rough, brown skin, and are up to four inches long. The smooth, thin, grayish-brown stems may be branched, and somewhat reclining to erect; these die back to the root each year. Leaves alternate along the stem, and are green with five finger-like lobes. Flowers are unisexual, with both male and female flowers occurring on the same plant; male flowers open later than females, and are at the top of the flowering stem. All flowers have short stalks, and sepals and petals appear similar and are white, and slightly purplish on the exterior. Bloom time follows rainfall. Fruiting stalks curve downward supporting a globe-like capsule about a half inch wide (USFWS, 1993c).

It was listed as endangered in 1991 (56 FR 49850 49854, October 2, 1991) and no critical habitat has been proposed (USFWS, 2015co). It occurs in Duval, Hidalgo and Starr Counties of the Lower Rio Grande Valley in south Texas and the adjacent state of Tamaulipas, Mexico (USFWS, 2015co).

Walker's manioc inhabits short native grasslands and the understory in open shrublands on relatively thin sandy loam soils associated with caliche (USFWS, 2009e). Threats to the species include loss of habitat or habitat modification due to residential and commercial development, road and utility construction and maintenance, mining, brush clearing for agriculture and range improvements, invasion or introduction of non-native species, oil and gas exploration and development, herbicide use, rooting by feral hogs, recreation, and the potential effects of climate change (USFWS, 1993c) (USFWS, 2009e).

White Bladderpod. White bladderpod is an annual herb in the mustard family. Seedlings germinate in November to December. Plants can be erect to spreading, reaching up to two feet tall, and usually branch at the base, but commonly above as well. Leaves are yellowish or grayish green, linear to oblong, with the edges variable (smooth to toothed or wavy or even lobed). Leaves at the base are up to four inches long and less than an inch wide on stalks about an inch and a half long. Stem leaves gradually become smaller up the stem, and are attached directly to the stem. The upper part of the stem has 6 to 20 or more flowers on short stalks. Flowers have four white petals with yellow bases and brown to olive-colored veins. Flowering time is April to May. Fruits are a round or egg-shaped pod less than a quarter inch in diameter (USFWS, 1992c).

It was listed as endangered in 1987 (52 FR 7424 7426, March 11, 1987) but no critical habitat has been proposed (USFWS, 1992c). It is an east Texas endemic, occurring in the Pineywoods region and known only from San Augustine County (USFWS, 2015cp).

White bladderpod is restricted to full sun, growing in open areas or the margins of thickets or glades with rock outcrops that produce limited areas of alkaline soils; soils are often saturated in winter and spring, but dry and harden in summer. Threats to the species include habitat loss due to invasion of its limited, specialized habitat by woody species and non-native invasive species, range management practices (e.g., herbicides, plowing, introduction of non-native pasture grasses), residential and commercial (i.e., mining) development and road and utility construction (USFWS, 1992c). The small population size is currently vulnerable to small-scale climate variables (such as early frosts and dry springs) and warmer, drier conditions associated with large-scale climate change are a threat as well (USFWS, 2014i).

Zapata Bladderpod. Zapata bladderpod is a perennial herb in the mustard family. Plants have long, spreading stems up to almost three feet long. The leaves are densely covered in short, star-like hairs, giving the plant a silvery green color. Leaves are linear to elliptic in shape, with smooth, wavy, or occasionally toothed edges. Leaves at the base are 1.5 to 5 inches long and 0.3 to 0.6 inches wide. Stem leaves are reduced in size ranging from 1 to 1.5 inches long and similarly very narrow. Flowers are on short stalks along much of the stem, and are a bright yellow. Bloom time follows rainfall, but generally falls between February and April. Fruits are a small round pod that can range from a quarter inch across to more than a half inch (USFWS, 2004).

It was listed as endangered in 1999 (64 FR 63745 63752, November 22, 1999) with critical habitat being designated in 2000 (65 FR 81182 81212, December 22, 2000). It occurs in Starr and Zapata Counties along the Lower Rio Grande in south Texas, and in the adjacent state of Tamaulipas, Mexico (USFWS, 2004), though recent analyses show the latter to be genetically distinct from Zapata bladderpod in Texas (USFWS, 2015cq). Critical habitat was designated within Starr County (USFWS, 2015cr).

Zapata bladderpod occurs in open, relatively sparsely vegetated upland shrub communities dominated by cenizo (*Leucophyllum frutescens*) and grades into more typical thornscrub with blackbrush acacia (*Acacia rigidula*) or guajillo (*Acacia berlandieri*) (USFWS, 2015cq) (USFWS, 2015cr). It is found on gravelly to sandy loam soils with a high gypsum or calcium carbonate content. Threats to the species include habitat modification and loss to residential and commercial development, road and utility construction, oil and gas exploration and development, and range management practices (e.g., plowing, introduction of non-native grasses, herbicides, overgrazing) (USFWS, 2004) (USFWS, 2015cq).

15.1.7. Land Use, Recreation, and Airspace

15.1.7.1. Definition of the Resources

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

Land Use and Recreation

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

Recreational uses are activities in which residents and visitors participate. They include outdoor activities, such as hiking, fishing, boating, athletic events (e.g., golf), and other attractions (e.g., historic monuments and cultural sites) or indoor activities, such as museums and historic sites. Recreational resources can include trails, lakes, forests, beaches, recreational facilities, museums, historic sites, and other areas/facilities (OECD, 2003). Recreational resources are typically managed by federal, state, county, or local governments.

Descriptions of land uses are presented in six primary categories: forest and woodlands, semi-desert, agricultural, shrub and grassland, developed, and public land / other land covers. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal. Descriptions of recreational opportunities are presented in a regional fashion.

Airspace

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

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

The FAA Air Traffic Services Unit (the Unit) manages the National Airspace System (NAS) and international airspace assigned to U.S. control and is responsible for ensuring efficient use, security, and safety of the nation's airspace. FAA field and regional offices (e.g., Aircraft Certification Offices, Airports Regional Offices, Flight Standards District Offices [FSDOs], Regional Offices & Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015k) (FAA, 2016a)[97]. The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

[97] Environmental and Noise compliants are initially handled at the HQ level

15.1.7.2. 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 Texas. However, most site-specific land use controls and requirements are governed by local county, city, and village laws and regulations. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities.

Because the Nation's airspace is governed by federal laws, there are no specific Texas state laws that would alter the existing conditions relating to airspace for this PEIS. Title 3 Aviation and Title 7 Local Government Code, Chapter 241 Municipal and County Zoning Authority Around Airports of the Texas Statutes addresses aviation for the state (Texas Constitution and Statutes, 2015a) (Texas Constitution and Statutes, 2015b).

15.1.7.3. Land Use and Ownership

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

Land Use

Table 15.1.7-1 identifies the major land uses by coverage type in Texas. Forest and woodlands compose the largest portion of land use with 25 percent of Texas' total land area occupied by this category (Table 15.1.7-1 and Figure 15.1.7-1). Semi-Desert is the second largest area of land use with 24 percent of the total land area. Agricultural land accounts for 21 percent while Shrub and Grassland encompasses 16 percent of the total land. Developed areas account for 5 percent of the total land area in Texas. (USGS, 2012c).

Table 15.1.7-1: Major Land Uses in Texas by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	65,682	25%
Semi-Desert	61,713	24%
Agricultural Land	53,857	21%
Shrub and Grassland	48,552	16%
Developed Land	13,669	5%
Public land and other land covers	17,759	9%

Source: (USGS, 2012c)

Forest and Woodland

Forest and woodland areas are primarily located in the central and eastern portions of the state, many of them interspersed with, and adjacent to, agricultural areas. Most forest and woodland areas throughout Texas are privately owned. Section 15.1.6, Biological Resources, presents additional information about terrestrial vegetation.

State Forests

State Forests account for 6,923 square miles of state land. There are five state forests, managed by the Texas A&M Forest Service, and scattered throughout the state:

- I.D. Fairchild (2,360 acres);
- W. Goodrich Jones (1,722 acres);
- John Henry Kirby Memorial Forest (600 acres);
- Masterson (519 acres); and
- E.O. Siecke (1,722 acres).

These forests are "working forests taken care of with sound scientific forest management that protects and keeps in existence native flora and fauna" (Texas A&M Forest Service, 2015a).

Private Forest and Woodland

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 state forests. For additional information regarding forest and woodland areas, see Section 15.1.6, Biological Resources, and Section 15.1.8, Visual Resources.

Semi-Desert

Land use within the semi-desert category in Texas includes wildlife management areas, wilderness areas, recreation areas, minerals development, wild horse management areas, and livestock grazing/ranching. Semi-desert areas cover 24 percent of Texas' land, are primarily located within the southwest (Figure 15.1.7-1), and are managed by private land owners, the state, Department of Defense (DOD), Department of Energy (DOE), National Park Service (NPS), USFWS, and American Indian tribes (Figure 15.1.7-2).

Agricultural Land

Agricultural land exists in every region of the state, with the largest concentrations in the northern and eastern halves of the state (Figure 15.1.7-1). Nearly one-quarter of Texas' total land area is classified as agricultural land (approximately 21 percent, or 53,857 square miles). In 2012, there were 248,809 farms in Texas and most were owned and operated by small, family businesses, with the average farm size of less than 50 acres (USDA, 2012). Some of the state's largest agricultural uses include cotton, hay, sorghum, corn, wheat, and peanuts. Other agricultural uses include livestock for dairy and meat, goats, sheep and hogs.

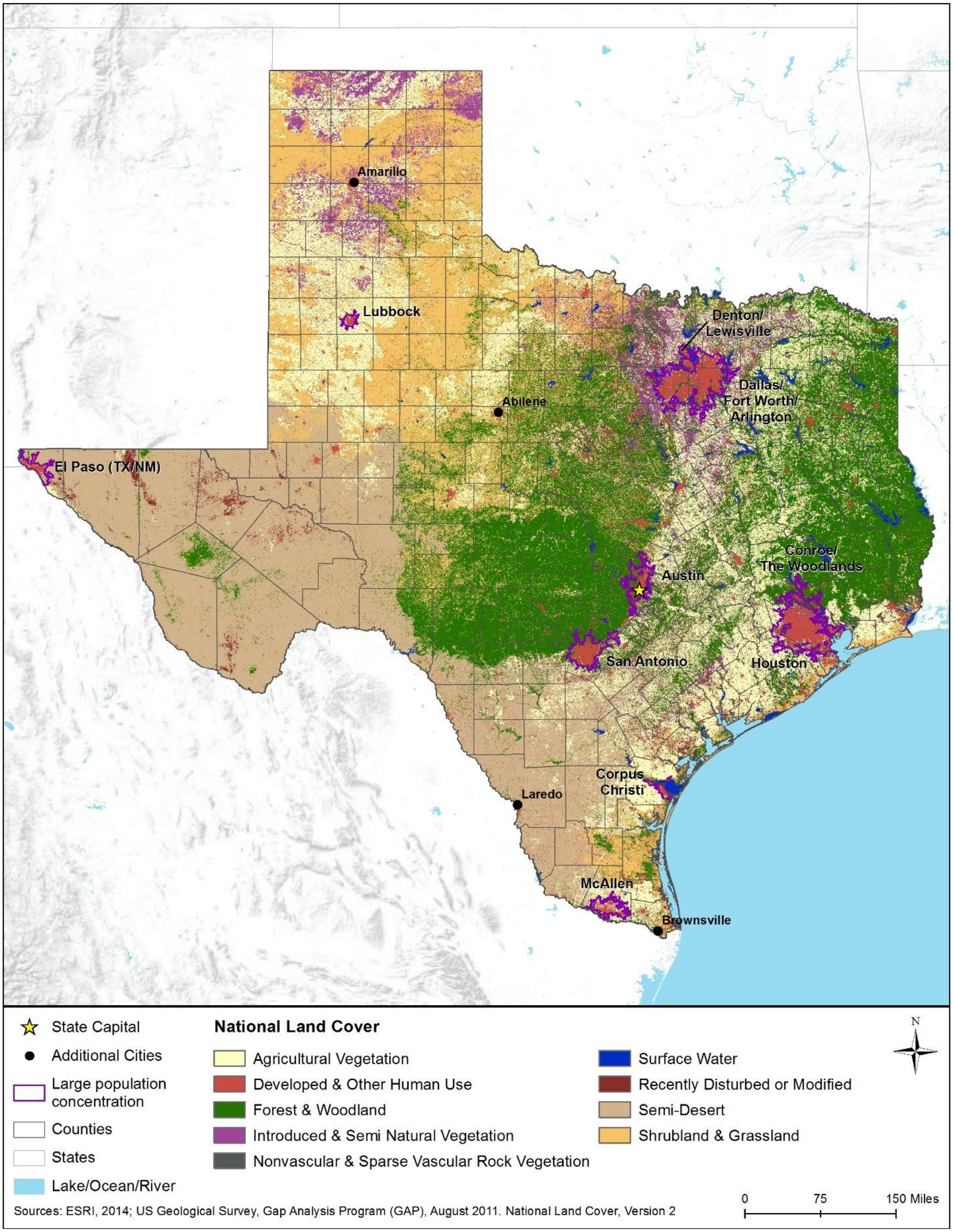


Figure 15.1.7-1: Major Land Use Distribution by Coverage Type

Developed Land

Developed land in Texas tends to be concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 15.1.7-1). Although only 5 percent of Texas land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 15.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 15.1.7-1 shows where these areas are located within the Developed land use category.

Table 15.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Dallas/Fort Worth/Arlington	5,235,068
Houston	5,067,551
San Antonio	1,798,985
Austin	1,421,159
El Paso (TX/NM)	778,719
Total Estimated State Population	**26,956,958**[a]

Source: (U.S. Census Bureau, 2015a), (U.S. Census Bureau, 2017)
[a] The estimated population in 2016 is 27,862,596.

Land Ownership

Land ownership within Texas has been classified into four main categories: private, federal, state, and tribal (Figure 15.1.7-2).[98]

Private Land

The majority of land in Texas is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 15.1.7-1). 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.[99]

Federal Land

The federal government manages over 6,300 square miles (2 percent) of Texas land with a variety of land types and uses, including national parks, monuments, historic sites, military bases, and national forests. Six federal agencies manage the majority of federal lands throughout the state (Table 15.1.7-3 and Figure 15.1.7-2) (USGS, 2012d) (USGS, 2014a). Table 15.1.7-3 identifies the federal agencies managing federal lands throughout the state. There may be other

[98] 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.
[99] Total acreage of private land could not be obtained for the state.

federal lands, but they are not shown on the map due to their small size relative to the entire state.

Table 15.1.7-3: Federal Land in Texas

Agency	Square Miles	Representative Type
DOE	15.9	Nuclear Facilities, Energy Efficiency Center
DOD (including USACE)	1,570.5	Military Bases, Air Force Bases, Military Camps, Army Depots
USFWS	745.14	National Wildlife Refuges
USDA Forest Service (USFS)	2,111.48	Wilderness and Forest Areas
NPS	1,923.64	Parks, Monuments, Historic Sites
National Oceanic and Atmospheric Administration	8.09	National Marine Fisheries Service Laboratory, Weather stations
Total	**6,374.75**	

Sources: (USGS, 2012d) (USGS, 2014a)

- The DOD manages several military installations in Texas, including Fort Hood, Fort Bliss, Ellington Air Force Base, and Randolph Air Force Base;
- The USFWS manages 18 NWRs in Texas, covering 745.14 square miles;
- The USFS manages four National Forests in Texas: Angelina National Forest, Davy Crockett National Forest, Sabine National Forest, and Sam Houston National Forest; and
- The NPS manages over 1,923 square miles consisting of 14 NPS units. (USGS, 2012d) (USGS, 2014a)

State Land[100]

The Texas state government owns 2,077.25 square miles of land composed of forests and woodlands, historic sites, state offices, and recreation areas (USGS, 2012d) (USGS, 2014a). Two main state agencies, State Parks and Recreation and State Fish and Wildlife, manage 99 percent of state lands (Table 15.1.7-4).

- There are 80 state parks located throughout the state, consisting of natural areas, lakes, rivers, forest areas and desert landscapes;
- TPWD's Wildlife Division manages 52 Wildlife Management Areas on 714,094 acres to provide opportunities for research, education, and public recreation, including hunting, hiking, camping, and bird watching;
- The TPWD Recreation Department maintains seven state natural areas (SNA) including Devil's Sinkhole SNA, Devil's River SNA, Enchanted Rock SNA, Government Canyon SNA, Hill Country SNA, Honey Creek SNA, and Lost Maples SNA; and
- The Texas Historical Commission (THC) manages 20 state historic sites including Caddo Mounds, Fulton Mansion, Levi Jordan Plantation, Sam Bell Maxey House, and San Felipe de Austin. (USGS, 2012d) (USGS, 2014a)

[100] 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.

Table 15.1.7-4: State Land in Texas

Agency	Square Miles[a]	Type
State Parks & Recreation	832.04	State parks and recreation areas
State Land Board	0.06	Miscellaneous
State Fish and Wildlife	1,119.10	Fish and wildlife management areas
State Department of Natural Resources	0.86	Natural areas
State Historical Commission	120.54	Historic sites
State Department of Transportation	0.09	State roads
Other State Land	4.56	Miscellaneous

Sources: (USGS, 2012d) (USGS, 2014a)

[a] Acres are not additive due to overlapping boundaries of the State Forests, State Parks and Recreation Areas, and Wildlife Management Areas.

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, currently manages 9.91 square miles of Texas lands containing three federally recognized Indian Reservations located in the eastern half of the state (USGS, 2012d) (USGS, 2014a).[101] For additional information regarding tribal land, see Section 15.1.11, Cultural Resources.

Table 15.1.7-5: Indian Reservations and Other Land Holdings of Texas

Reservation Name	Square Miles
Alabama and Coushatta Reservation	9.45
Kickapoo Traditional Tribe (Texas)	0.25
Ysleta Del Sur Pueblo	0.21
Total	**9.91**

Sources: (USGS, 2012d) (USGS, 2014a)

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

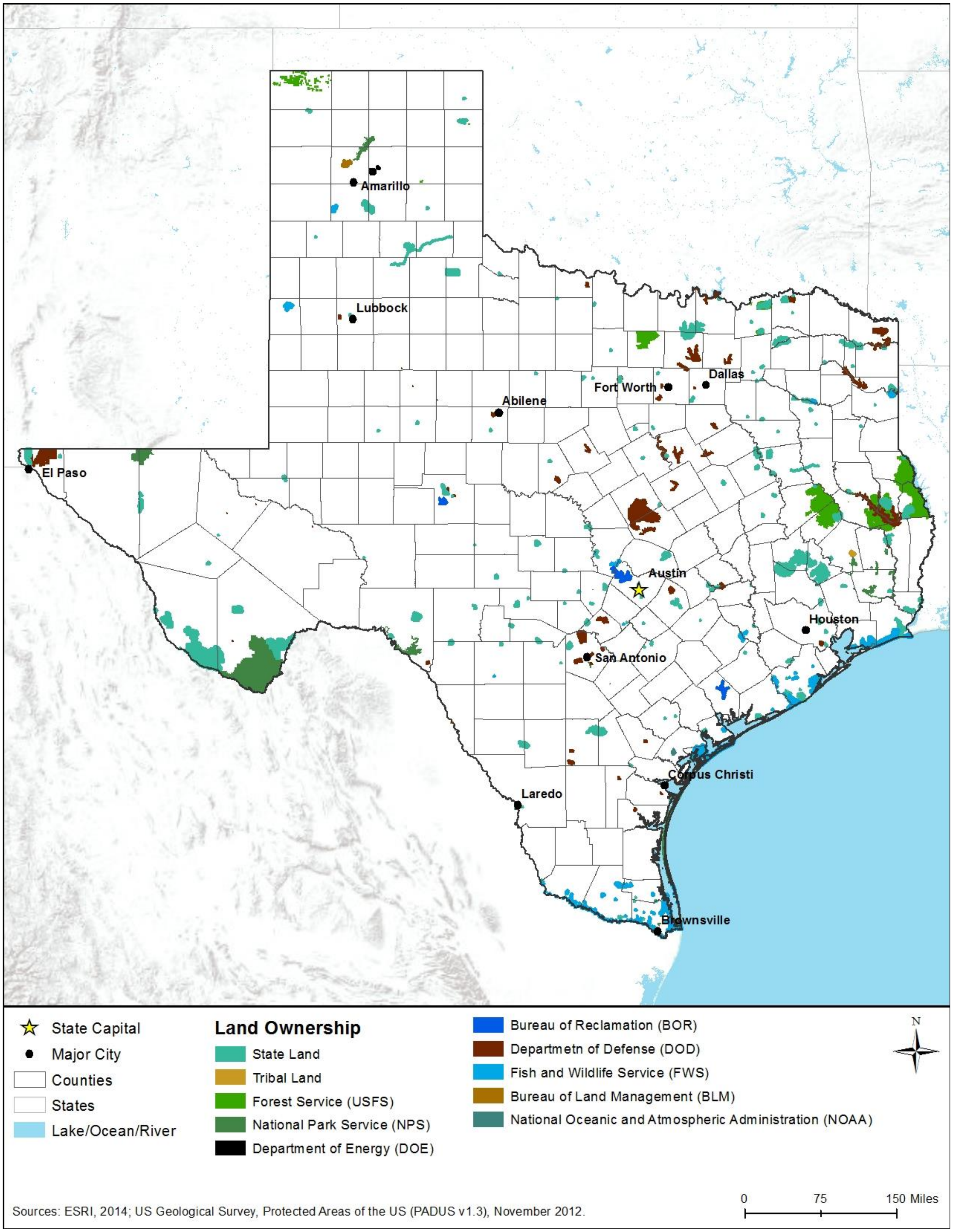


Figure 15.1.7-2: Land Ownership Distribution

15.1.7.4. Recreation

Texas is only exceeded in size by Alaska. This expansiveness makes Texas' natural environment, resources, climate, population, and development extremely varied. The Rio Grande River, deserts, and plains of the west, give way to the plateaus, rolling hills, and pine forests of the east. The metro areas of Houston, Dallas-Ft. Worth, and San Antonio are heavily populated compared to the western region. The Rio Grande, Red, Brazos, Pecos, Colorado, Canadian, Trinity, Sabine, Neches, Nueces, Guadalupe, and San Antonio are the 12 primary rivers. Southern Texas' Gulf of Mexico coastal region has beaches, barrier islands, bays, estuaries, and swamps. Fresh and salt water-based recreation, fishing, boating and camping opportunities in Texas are greatly enhanced by these resources. On the community level, cities and towns provide an assortment of indoor and outdoor recreational facilities including: community and recreation centers, theaters, museums, athletic fields and courts, golf courses, multi-use trails, playgrounds, picnicking areas, theme/amusement parks, boat launches and marinas. Availability of community-level facilities is typically commensurate to the population's distribution and interests, and the natural resources prominent in the vicinity (Tour Texas, 2017).

There are 109 state properties, including parks/recreation areas/natural areas/historical areas (TPWD, 2015a), 5 state forests (Texas A&M Forest Service, 2015b), more than 191,000 miles of streams/rivers, and over 196 major reservoirs/lakes (TWDB, 2015a).

Federally, the NPS, USFS, USFWS, and USACE manage areas in Texas with substantial recreational attributes. There are two National Monuments, two National Recreation Areas, two National Parks, one National Preserve, one National Memorial, two National Historic Trails, one National Historic Site, three National Historical Parks, and one National Seashore (USFS, 2015a). Section 15.1.8, Visual Resources, identifies all the National Parks and affiliated areas located in Texas (see Table 15.1.8-4 and Figure 15.1.8-1).

This section discusses key recreational opportunities and activities representative of various regions of Texas. The state can be categorized by seven distinct recreational regions, each of which are presented in the following sub-sections (Figure 15.1.7-3) (Tour Texas, 2015a).[102] For information on culturally/historically significant resources, see Section 15.1.11, Cultural Resources.

[102] 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.

Panhandle Region

The Panhandle Region is bounded by Oklahoma to the north and New Mexico to the west. The cities of Amarillo, Lubbock, and Big Spring are located in the western portion of this region; Abilene in the south central, Wichita Falls and Mineral Wells are near the eastern boundary; and San Angelo is at the southern boundary. Although not a highly populated region, the region is primarily a Great Plains terrain with prairies, grasslands, plateaus, with some beautiful canyon lands.

Lake Meredith National Recreation Area is an oasis for this region's dry high plains. It provides extensive recreation opportunities for visitors including all varieties of water sports, hiking, mountain biking, OHV and horse riding, hunting, fishing and camping. (NPS, 2015a) Palo Duro Canyon State Park (2nd largest canyon in the U.S.) near Amarillo is a popular destination for visitors (TPWD, 2015b). The city of Lubbock is best known for its art galleries, performing arts and sports venues, and wine country. Wichita Falls offers this region's best opportunities for cultural and arts experiences, special events, exhibitions, festivals, and sports venues. Near Mineral Wells, Possum Kingdom and Lake Mineral Wells State Parks have excellent opportunities for boating, fishing, hiking, rock climbing, and camping. San Angelo State Park is popular for equestrians, as well as for mountain biking, fishing, and hunting (Tour Texas, 2015b).

Prairies and Lakes Region

This region is roughly defined by the Red River, Oklahoma, and the Dallas-Ft. Worth (DFW) metro area to the north, west of Mt. Pleasant, Tyler, and Huntsville, east of Austin, and north of Houston. The DFW metropolitan area and surrounding urban areas extensive opportunities for entertainment, museums, gardens, natural history venues, performing arts, music, and professional sports. The Dallas Arts District boasts of being the largest in the country. White Rock Lake (and water park) located centrally in the city has a nine mile multi-use path around it and provides swimming, paddle boarding, sailing, rowing, and canoeing options. Several large lakes edge this metropolis providing more easily accessible water-based recreation. Nearby nature preserves, centers, trails, and golf courses are also present. Six Flags over Texas amusement park and the NASCAR and Indy-car Texas Motor Speedway are also popular destinations for locals and visitors.

North of DFW, on the Oklahoma border is the Red River and Lake Texoma, with Eisenhower State Park providing a wide variety of supporting recreational activities associated with these resources. Numerous other small reservoirs and lakes are located in this region, and most have associated state parks at their shorelines or nearby. Dinosaur Valley State Park and Fossil Rim Wildlife Center are unique attractions in this region. (Tour Texas, 2015c)

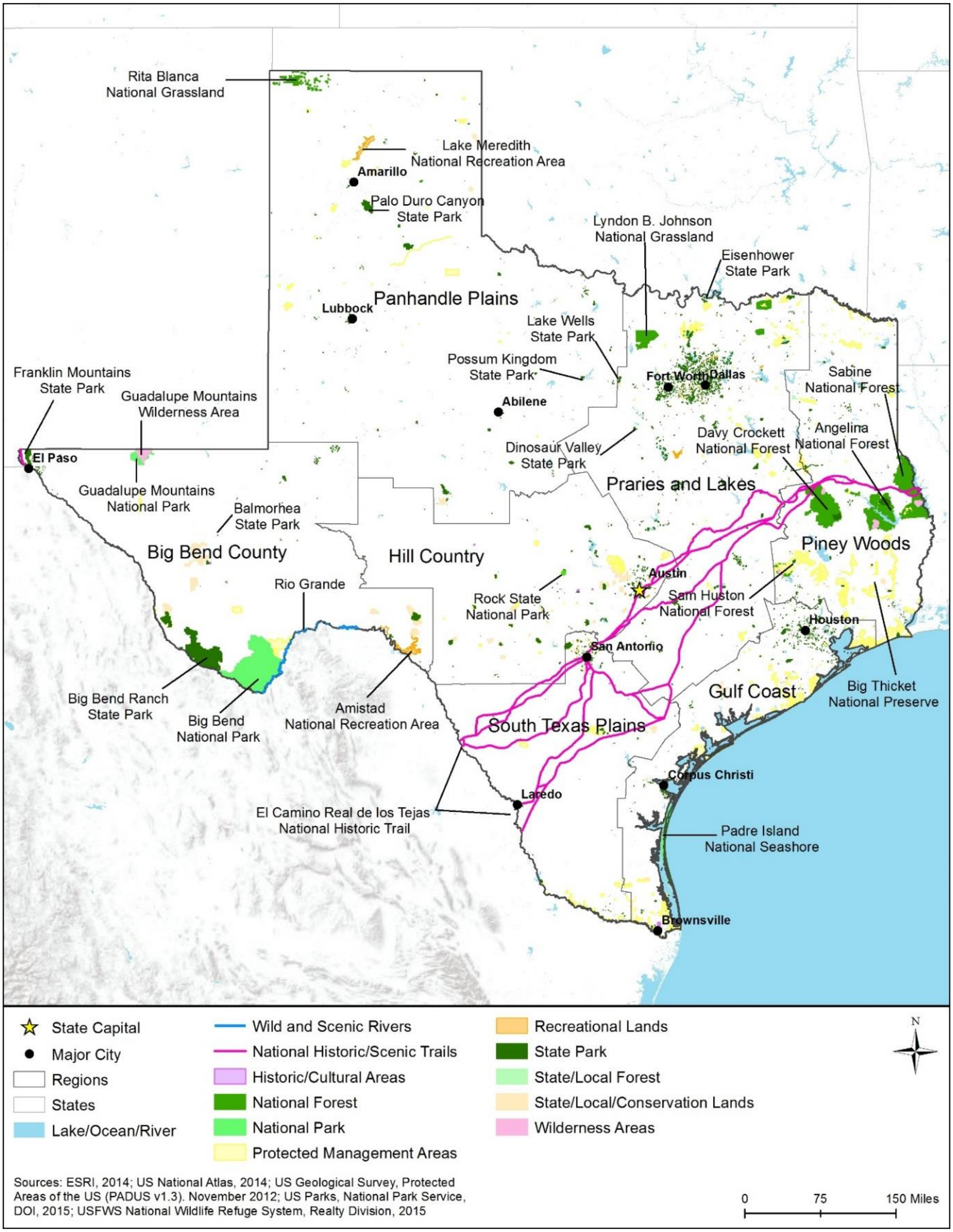


Figure 15.1.7-3: Texas Recreation Map

Piney Woods Region

This region is roughly defined as the area east of DFW (Mt. Pleasant, Tyler, Nacogdoches, and Huntsville as the western border) and north of Houston (from The Woodlands community) to the Oklahoma and Arkansas border. Arkansas, Louisiana, Toledo Bend Reservoir, and the Sabine River are the eastern boundaries. This is the most forested region in the state. Fishing and golf are very popular in this region. The enormous Toledo Bend and Sam Rayburn Reservoirs and their adjacent Sabine and Angelina National Forests offers a water and forest recreation playground for visitors. Sam Houston National Forest has the 130-mile Lone Star Hiking Trail and Lake Conroe. Jacksonville also known as 'Mudville' due to the 2 ATV Parks developed there (Mud Creek Off-Road Park and River Run ATV Park). Mount Pleasant is the gateway to some of the best fishing and water recreation in the state, with Lake Bob Sandlin, Lake Monticello, Lake Cypress Springs, Lake Welsh and others. Tyler's roses and Nacogdoches' azaleas bring flower-lovers to visit these two cities. (Tour Texas, 2015d)

Big Thicket National Preserve is a unique natural site containing nine different ecosystems that support some of the most diverse species of plant and animal life of anywhere in the world. It is a UNESCO Biosphere Reserve, drawing national and international visitors. Hiking, canoeing, kayaking, primitive camping, bird watching, and hunting are the most common visitor activities. (NPS, 2015b)

Gulf Coast Region

This region stretches from Port Arthur at the far eastern edge of where Louisiana and Texas meet the Gulf of Mexico, to the southwestern-most city of Brownsville on the Mexico and Rio Grande River border. Beaumont, Houston, Galveston, and Corpus Christie are the other key cities in this region. Beach enthusiasts enjoy the more than 600 miles of coastline beaches for sunbathing, shell collecting, swimming, surfing, picnicking, boating, and fishing. NWRs are plentiful for hikers, wildlife watchers, and photographers; as is the Texas Coast Birding Trail. Houston is renowned for its theater and museum districts and as home of "Space Center Houston", NASA's Johnson Space Center Visitor Center, one of the most popular visitor destinations in Texas. Ocean Star Offshore Drilling Rig Museum in Galveston is a unique attraction; as is the aircraft carrier U.S. Lexington Museum in Corpus Christi. (Tour Texas, 2015e)

Padre Island National Seashore is the world's longest undeveloped barrier island with 70 miles of coastline. Beach activities, wildlife viewing, swimming, windsurfing, kiteboarding, and saltwater fishing are favorite recreational pursuits. The Laguna Madre located between the barrier reef and the Texas shoreline is a hypersaline lagoon (one of six worldwide) that is an important haven for migratory and wintering birds, and the state's most productive bay fishery. (NPS, 2015c)

South Plains Region

This region is just west of the Coastal Region and extends to the southern and western border of the Rio Grande River and Mexico. To the north is the Hill Country and Austin, and a small portion of the Prairies and Lakes Region. San Antonio is the cultural and leisure recreation center of this region—home of the historic Alamo, the 15-mile Riverwalk, the Fiesta Festival (more than 3.5 million people attend), SeaWorld, a zoo, wildlife ranch, botanical garden, caverns, water park, and exceptional golf courses. South of San Antonio, the cities of Laredo and McAllen (located on the Rio Grande River border with Mexico) are the largest cities in this rural area. Choke Canyon and International Falcon Reservoirs are two of the largest lakes in this region and cater to water sports recreationists. (Tour Texas, 2015f)

Hill Country Region

Located just slightly southwest of central Texas, Hill Country terrain is one of rolling hills, oak forests, limestone cliffs and caverns, spring fed rivers, and lakes. Austin, the state capital, is also a renowned music and entertainment district. The nearby Lady Bird Johnson Wildflower Center is a popular attraction as is Lake Travis. This region's area is well known for its wineries, craft breweries, and commercial farming of lavender.

Texas counties in Hill Country's northwest edge are favored by hunters for their abundance of wildlife that feast on acorns, walnuts, and pecans from the local forests. The Highland Lakes area (Lakes Buchanan, LBJ, Inks, Travis, and Marble Falls) located northwest of Austin provide recreational activities such as water sports, hunting, fishing, birding, hiking, biking, and camping. Enchanted Rock State Natural State Park is popular for hiking and camping with its pink granite dome and views of the Hill Country. Bandera County's numerous Dude Ranches are popular destinations for visitors wanting to experience the day-to-day life of cattle ranchers and cowboys. Jacob's Well Natural Area is an artesian spring-fed underground cave near Woodcreek that is a unique destination for tourists. (Tour Texas, 2015g)

Big Bend Region

This region is the westernmost, roughly from Del Rio to Midland on the east, New Mexico to the north, and the Rio Grande River and Mexico to the west and south. It is sparsely populated, with desert lowlands, plains, rugged canyons, and over 24 small mountain ranges. Big Bend National Park and Big Bend Ranch State Park are the dominant recreation destinations in this region, covering over 1 million acres adjacent to the southern "bend" of the Rio Grande River. The unique diversity of animals, plants, and scenic vistas present in the park is due to the extreme variety of habitats intersecting here: deserts, mountains, canyons, and rivers. There are over 150 miles of trails through all of these habitats. Backpacking, horseback riding, fishing, wildlife viewing, astronomy, and river trips are popular activities. (USDOI, 2015) Big Bend Ranch State Park is Texas' largest state park and certainly the most remote. It has an airstrip, 238 miles of multi-use trails, and 70 miles of OHV roads. Backcountry and equestrian camping are popular activities. (TPWD, 2015c) 191 miles of the Rio Grande River is classified as "Wild and Scenic" from Big Bend National Park to the Terrell-Val Verde County line (National Wild and Scenic Rivers System, 2015a).

The 24,000 acre Franklin Mountains State Park is the country's largest state park within an urban setting, this being the city of El Paso. Outdoor enthusiasts flock to its local rock climbing and bouldering sites, and over 100 miles of multi-use trails for hiking, running, mountain biking, and horseback riding. (Tour Texas, 2015h) Guadalupe Mountain National Park is a favorite destination for those wanting to explore the remote pristine wilderness it encompasses and the unique fossil reef geological formations it contains. Visitors also come to enjoy opportunities for nature photography, star gazing, birding, hiking, backpacking, and camping. (NPS, 2015d) Amistad National Recreation Area (and Reservoir) is an oasis with opportunities for swimming, scuba diving, boating, kayaking, fishing, camping, and hiking. Balmorhea State Park boasts of the largest spring-fed swimming pool in the world. (Tour Texas, 2015i)

15.1.7.5. 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.

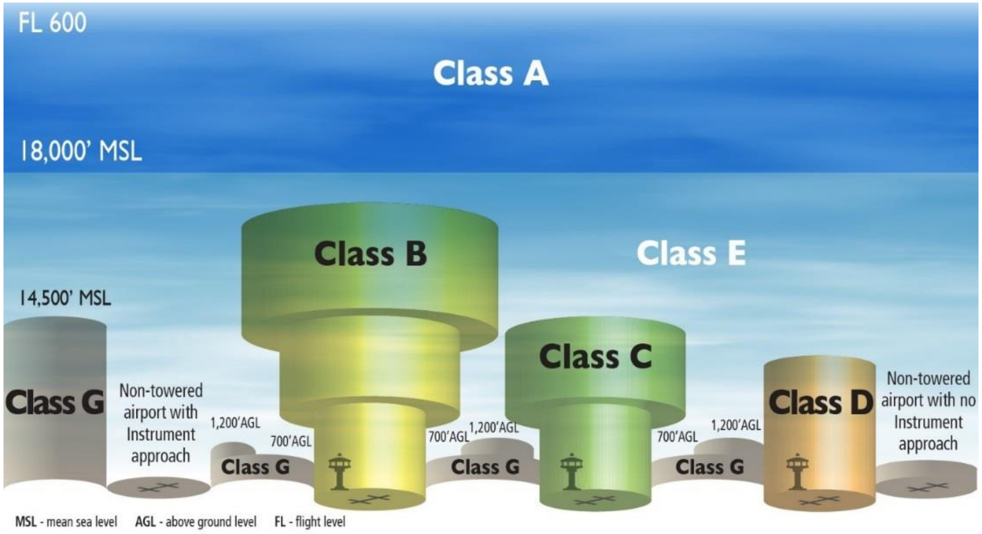
Airspace Categories

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 15.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[103] service is based on the airspace classification (FAA, 2008).

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



Source: Derived from (FAA, 2008)

Figure 15.1.7-4: National Air Space Classification Profile

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)[104]. 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).[105]
- **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).

[104] 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)"
[105] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015j).

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 15.1.7-6).

Table 15.1.7-6: SUA Designations

SUA Type	Definition
Prohibited Areas	"Airspace of defined dimensions identified by an area on the surface of the earth within which the flight of aircraft is prohibited. Such areas are established for security or other reasons associated with the national welfare. These areas are published in the Federal Register and are depicted on aeronautical charts."
Restricted Areas	"Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Activities within these areas must be confined because of their nature or limitations imposed upon aircraft operations that are not a part of those activities or both. Restricted areas denote the existence of unusual, often invisible, hazards to aircraft such as artillery firing, aerial gunnery, or guided missiles. Penetration of restricted areas without authorization from the using or controlling agency may be extremely hazardous to the aircraft and its occupants. Restricted areas are published in the Federal Register and constitute 14 CFR Part 73."
Warning Areas	"Airspace of defined dimensions, extending from three NM from the U.S. coast, which contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn non-participating pilots of the potential danger. A warning area may be located over domestic or international waters or both."
MOAs	"Airspace of defined vertical and lateral limits established for separating certain military activities (e.g., air combat maneuvers, air intercepts, testing, etc.) from IFR traffic. Whenever an MOA is in use, non-participating IFR traffic may be cleared through a MOA if IFR separation can be provided by ATC. Otherwise, ATC will reroute or restrict nonparticipating IFR traffic."
Alert Areas	"Depicted on aeronautical charts to inform non-participating pilots of areas that may contain a high volume of pilot training or an unusual type of aerial activity. Pilots should be particularly alert when flying in these areas. All activity within an alert area must be conducted in accordance with CFRs, without waiver, and pilots of participating aircraft and pilots transiting the area are responsible for collision avoidance."
Controlled Firing Areas (CFAs)	"Activities that, if not conducted in a controlled environment, could be hazardous to nonparticipating aircraft. The distinguishing feature of the CFA, as compared to other special use airspace, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. There is no need to chart CFAs since they do not cause a nonparticipating aircraft to change its flight path."
National Security Areas (NSA)	"Airspace of defined vertical and lateral dimensions established at locations where there is a requirement for increased security and safety of ground facilities. Pilots are requested to voluntarily avoid flying through the depicted NSA. When it is necessary to provide a greater level of security and safety, flight in NSAs may be temporarily prohibited by regulation under the provisions of 14 CFR Section 159.7. 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, 2015a) (FAA, 2008)

Other Airspace Areas

Other airspace areas, explained in Table 15.1.7-7, 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 15.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • 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. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the state of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of “permanent” are included in this 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, 2015a) (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.; and
  - 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; and
- Any construction or alteration located on a public use airport or heliport regardless of height or location" (FAA, 2015b).

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.

Texas Airspace

The Aviation Division of the Texas Department of Transportation is responsible for "assisting cities and counties in administration of federal and state funds used for the general aviation airports in the 300-airport Texas Airport System Plan. The division also implements a federal improvement program for general aviation airports, and operates a fleet of state-owned aircraft for the transportation needs of state officials and employees" (TxDOT, 2015a). There are four FAA FSDOs for Texas located in Houston, North Texas (Irving), Lubbock, and San Antonio (FAA, 2016b).

Texas 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). Table 15.1.7-8 presents the different aviation airports/facilities residing in Texas, while Figure 15.1.7-6 and Figure 15.1.7-7 presents the breakout by public and private airports/facilities. There are approximately 2,002 airports within Texas as presented in Table 15.1.7-8 and Figure 15.1.7-5 through Figure 15.1.7-7 (USDOT, 2015a).

Table 15.1.7-8: Type and Number of Texas Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	386	1,050
Heliport	6	546
Seaplane	0	0
Ultralight	0	8
Balloonport	0	0
Gliderport	0	6
Total	**392**	**1,610**

Source: (USDOT, 2015a)

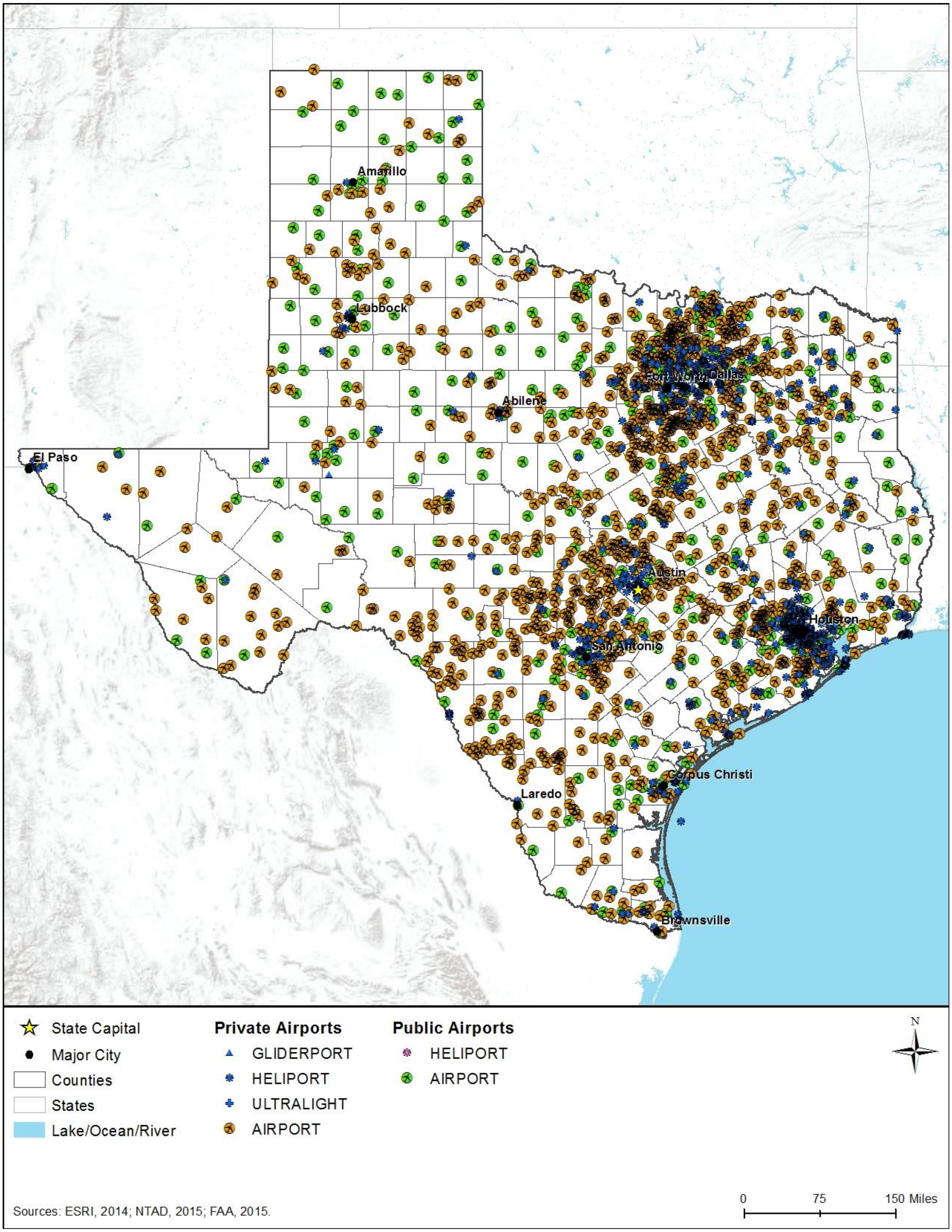


Figure 15.1.7-5: Composite of Texas Airports/Facilities

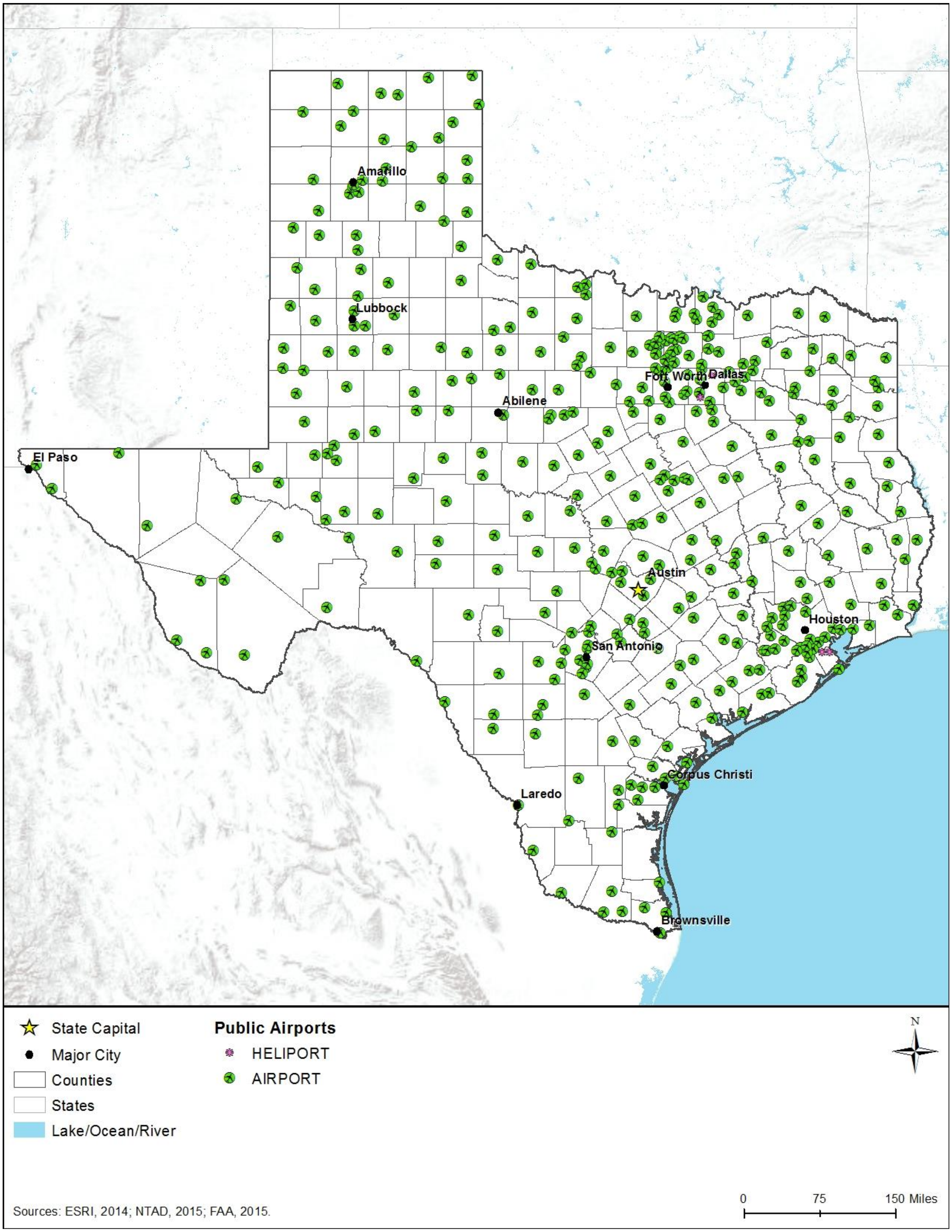


Figure 15.1.7-6: Public Texas Airports/Facilities

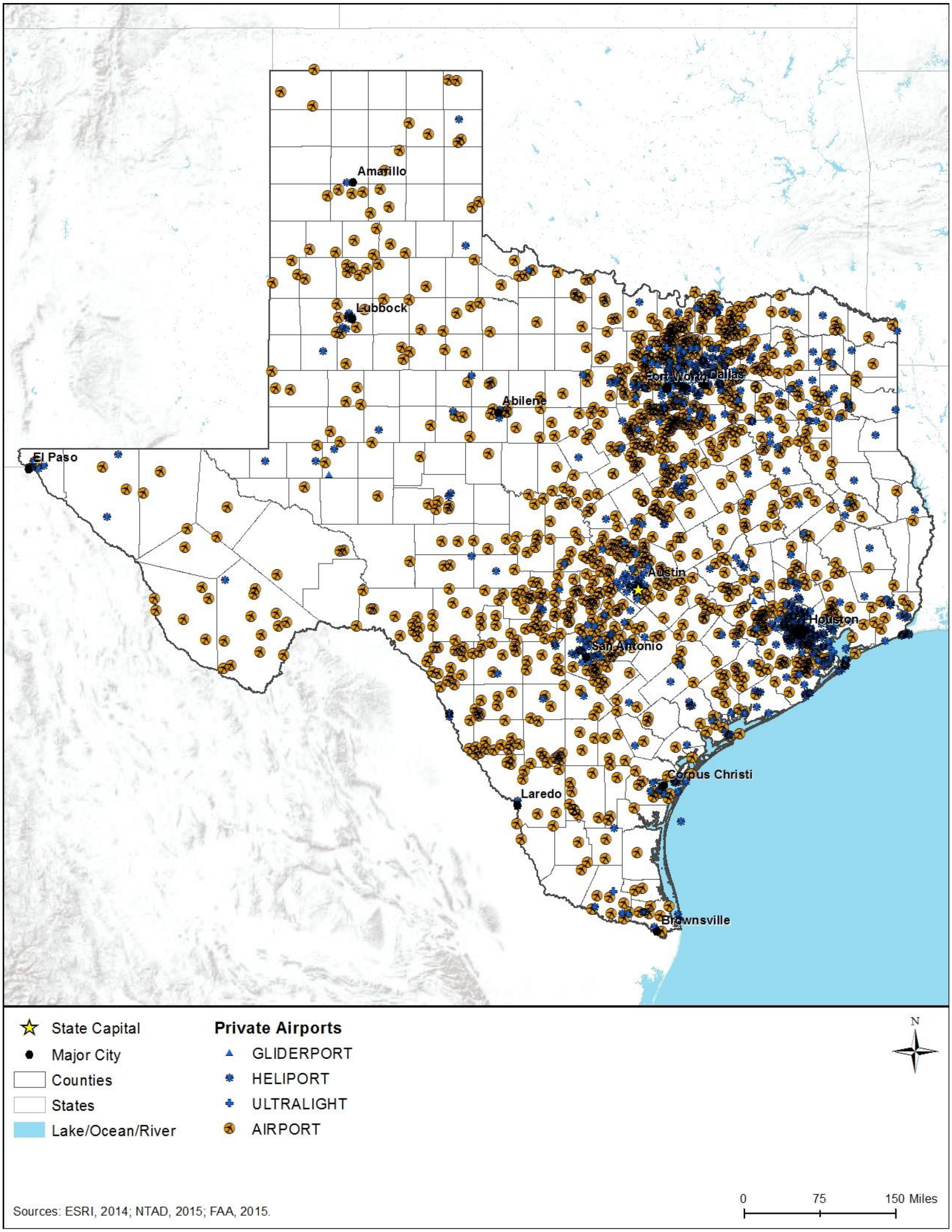


Figure 15.1.7-7: Private Texas Airports/Facilities

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

- Two Class B:
  - Dallas/Fort Worth International, Dallas-Fort Worth; and
  - George Bush Intercontinental, Houston.
- Eleven Class C:
  - Abilene Regional;
  - Amarillo International;
  - Austin-Bergstrom International, Austin;
  - Corpus Christi International;
  - Dyess Air Force Base (AFB), Abilene;
  - El Paso International;
  - Rio Grande Valley International, Harlingen;
  - Laughlin AFB, Del Rio;
  - Lubbock International;
  - Midland International ; and
  - San Antonio International.
- 44 Class D:
  - Orange Grove Naval Auxiliary Landing Field, Alice;
  - Arlington Municipal;
  - Jefferson County Airport, Beaumont;
  - Brownsville/South Padre Island International, Brownsville;
  - Easterwood Field, College Station;
  - Lone Star Executive, Conroe;
  - Cabaniss Navy Outlying Field, Corpus Christi;
  - Waldron Navy Landing Airfield, Corpus Christi;
  - Corpus Christi Naval Air Station (NAS)/Truax Field, Corpus Christi;
  - Dallas, Addison Airport, Dallas;
  - Dallas, Redbird Airport, Dallas;
  - Denton Municipal;
  - Fort Worth Alliance, Fort Worth;
  - Fort Worth Meacham, Meacham;
  - Fort Worth NAS Joint Reserve Base (Carswell Field), Fort Worth;
  - Fort Worth Spinks, Fort Worth;
  - Scholes International at Galveston, Galveston;
  - Georgetown Municipal;
  - Grand Prairie Municipal;
  - Majors Airport, Greenville;
  - David Wayne Hooks Memorial, Houston;
  - Ellington Field, Houston;
  - Sugar Land Municipal/Hull Field, Sugar Land;
  - Kingsville NAS, Kingsville;
  - Laredo International;
  - Gregg County, Longview;

  - Mesquite Metro, Mesquite;
  - Miller International, McAllen;
  - McKinney Municipal;
  - New Braunfels Municipal;
  - Robert Gray Army Airfield (AAF), Killeen;
  - Hood AAF, Killeen;
  - Killeen Municipal;
  - Mathis Field, San Angelo;
  - Kelly AFB, San Antonio;
  - Stinson Municipal Airport, San Antonio;
  - Randolph AFB, San Antonio;
  - San Marcos Municipal;
  - Grayson County, Sherman;
  - Tyler Pounds Field, Tyler;
  - Victoria Regional;
  - Waco Regional;
  - Texas State Technical College-Waco; and
  - Sheppard AFB/Wichita Falls Municipal, Wichita Falls. (FAA, 2015c)

SUAs (i.e., 2 prohibited areas, 9 restricted areas, 5 warning areas, 38 MOAs, and 13 alert areas) located in Texas are as follows:

- Amarillo (Prohibited):
  - P-47 – Surface to 4,800 feet MSL (1,200 feet AGL).
- Crawford (Prohibited):
  - P-49 – Surface to 2,000 feet MSL.
- Fort Hood (Restricted):
  - R-6302A – Surface to 30,000 feet MSL;
  - R-6302B – Surface to 11,000 feet MSL;
  - R-6302C – Surface to 30,000 feet MSL;
  - R-6302D – Surface to 30,000 feet MSL; and
  - R-6302E – 30,000 feet MSL to 45,000 feet MSL.
- Cotulla (Restricted):
  - R-6312 – Surface to FL 230; Excluding the area west of a line between lat. 28°17’41”N., long. 98°47’56”W.; and lat. 28°11’56”N., long. 98°48’01”W.; and the area along Highway 624 extending ¼ mile each side where the floor is 1,000 feet AGL.
- Eagle Pass (Restricted):
  - R-6316 – Surface to 15,000 feet MSL.
- El Sauz (Restricted):
  - R-6317 – Surface to 15,000 feet MSL.
- Marfa (Restricted):
  - R-6318 – Surface to 14,000 feet MSL (FAA, 2015d).

The 38 MOAs for Texas are as follows:

- Brady:
  - High – 6,000 feet MSL to, but not including, FL 180;
  - Low – 500 feet AGL to, but not including, 6,000 feet MSL; Excluding the following airspace: (1) Within a three NM radius of the Curtis, TX Airport (lat. 31°11’01”N., long 99°19’28”W.) and within three NM each side of the 180o true bearing of the airport to the southern boundary of the MOA. From the surface to 1,500 feet AGL. (2) Within a three NM radius of the San Saba Co Muni, TX, Airport (lat. 31°14’07”N., long. 98°43’01”W.) and within three NM each side of the 145o true bearing of the airport to the eastern boundary of the MOA. From the surface to 1,500 feet AGL.
  - North – 3,600 feet MSL up to, but not including, FL 180.
- Bronco:
  - 1 – 8,000 feet MSL to, but not including, FL 180;
  - 2 – 10,000 feet MSL to, but not including, FL 180;
  - 3 – 10,000 feet MSL to, but not including, FL 180; and
  - 4 – 10,000 feet MSL to, but not including, FL 180.
- Brownwood:
  - 1 East – 7,000 feet MSL to, but not including, FL 180;
  - 1 West – 7,000 feet MSL to, but not including, FL 180;
  - 2 East – 7,000 feet MSL to, but not including, FL 180;
  - 2 West – 7,000 feet MSL to, but not including, FL 180;
  - 3 – 13,000 feet MSL to, but not including, FL 180; and
  - 4 – 13,000 feet MSL to, but not including, FL 180.
- Crystal MOA:
  - 6,000 feet MSL to, but not including, FL 180.
- Crystal North:
  - 6,000 feet MSL up to, but not including, FL 180.
- Gray:
  - 2,000 feet MSL to 10,000 feet MSL.
- Hood MOA – 2,000 feet MSL to and including 10,000 feet MSL.
- Hood High – 10,000 feet MSL to, but not including, FL 180; Excluding Hood MOA and Gray MOA when active.
- Kingsville:
  - 1 – From 8,000 feet up to, but not including, FL 180;
  - 2 – From 13,000 feet up to, but not including, FL 180;
  - 3 – From 8,000 feet MSL up to, but not including, FL 180;
  - 4 – 9,000 feet MSL to, but not including, FL 180; and
  - 5 – 9,000 feet MSL to, but not including, FL 180.
- Lancer:
  - 6,200 feet MSL up to, but not including, FL 180.

- Laughlin:
  - 1 – 9,000 feet MSL up to, but not including, FL 180;
  - 2 – 7,000 feet MSL to, but not including, FL 180;
  - 3 High – 15,000 feet MSL up to, but not including, FL 180; and
  - 3 Low – 7,000 feet MSL up to, but not including, 15,000 feet MSL.
- Randolph:
  - 1A – 8,000 feet MSL to, but not including, FL l80;
  - 1B – 7,000 feet MSL to, but not including, FL 180;
  - 2A – 9,000 feet MSL to, but not including, FL 180; and
  - 2B – 14,000 feet MSL to, but not including, FL 180.
- Sheppard:
  - 1 – 8,000 feet MSL to, but not including, FL 180; and
  - 2 – 8,000 feet MSL to, but not including, FL 180.
- Texon:
  - 6,000 feet MSL to, but not including, FL 180; Air Traffic Control assigned airspace will be provided from FL 180 to FL 230.
- Valentine:
  - 15,000 feet MSL to, but not including, FL 180.
- Westover:
  - 1 – 9,000 feet MSL to, but not including, FL 180; and
  - 2 – 10,000 feet MSL to, but not including, FL 180 (FAA, 2015d).

The eleven Alert Areas are as follows:

- Gulf Coast FAA Houston Center:
  - A-381 – Surface to 2,000 feet MSL (Digital Aeronautical Flight Information File, 2015).
- Corpus Christi:
  - A-632A – 6,000 feet MSL to, but not including, FL 180;
  - A-632B Corpus Christi Extension – Surface to, but not including, FL 180;
  - A632C – From the surface to, but not including, FL 180;
  - A632D – From 6,000 feet MSL to, but not including, 11,000 feet MSL;
  - A632E – From 6,000 feet MSL to, but not including, 9,000 feet; and
  - A632F – 3,000 feet AGL to, but not including, FL 180.
- Laughlin AFB:
  - A-633A – Surface to 7,000 feet MSL; and
  - A-633B – Surface to 4,000 feet MSL.
- Randolph:
  - A-635 – 1,500 feet MSL to and including 4,000 feet MSL.
- Randolph (Hondo, Texas):
  - 200 feet AGL to 7,500 feet MSL (Digital Aeronautical Flight Information File, 2015).
- Wichita Falls:
  - A-636 – From the surface to and including 4,000 feet MSL.
- Seguin:
  - A-638 – Surface to 3,000 feet MSL. (FAA, 2015d).

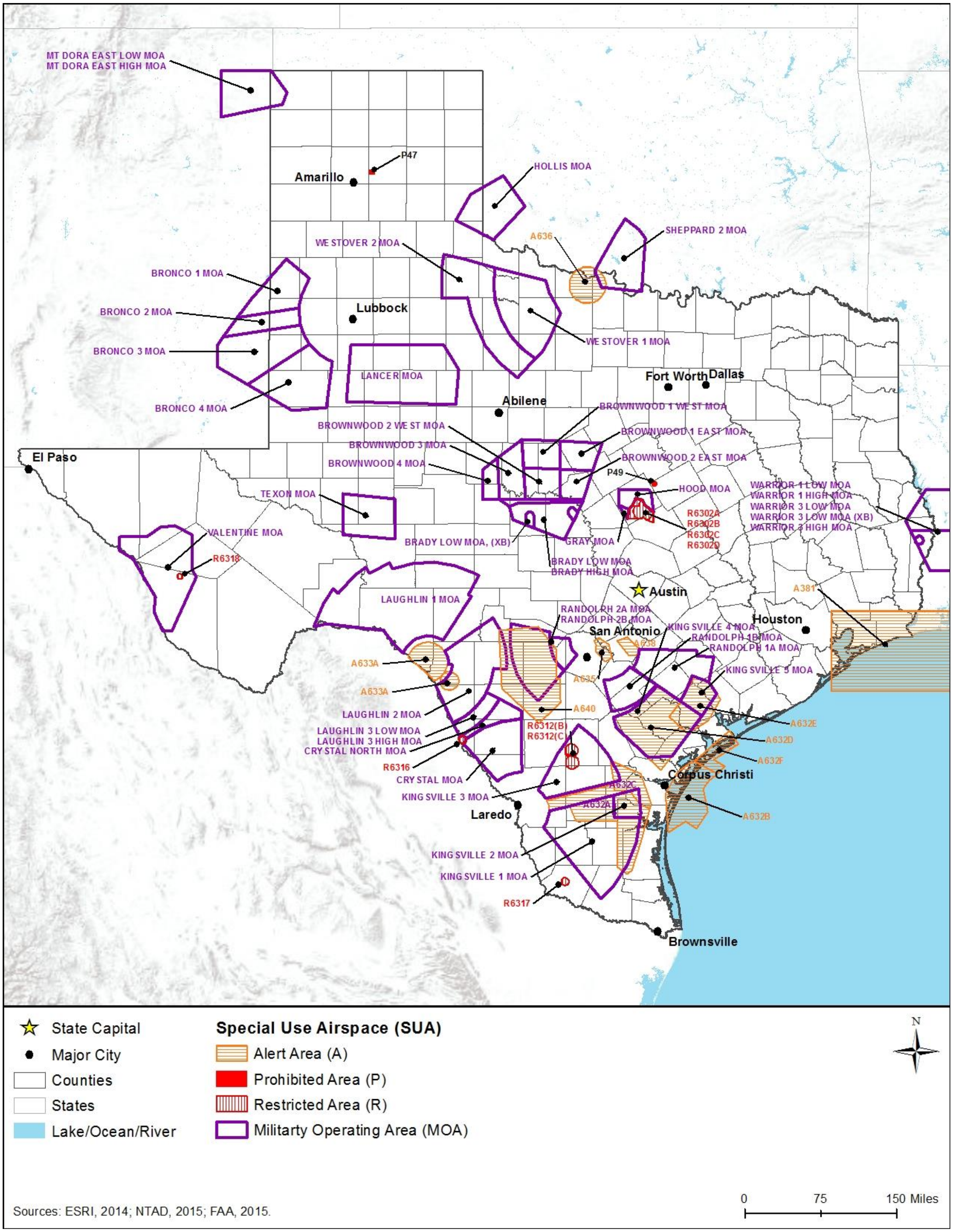


Figure 15.1.7-8: SUAs in Texas

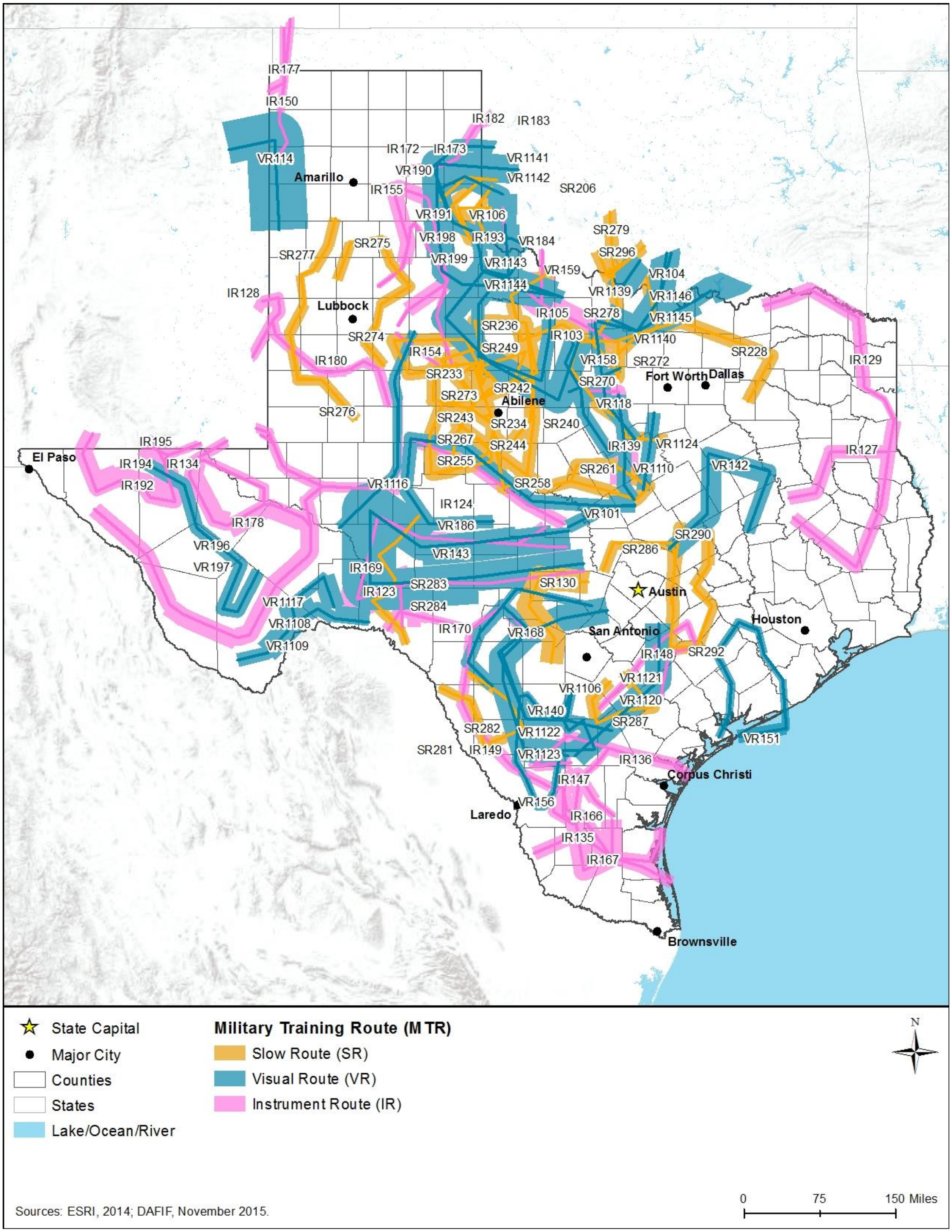


Figure 15.1.7-9: MTRs in Texas

The SUAs for Texas are presented in Figure 15.1.7-8. There is one TFR (32123) (See Figure 15.1.7-8) (FAA, 2015e). Figure 15.1.7-9 presents the MTRs in Texas consisting of 16 Visual Routes, 9 Instrument Routes, and 8 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 National Park Service" (NPS, 2014a). There are 14 NPS units in Texas that must comply with this agency directive (NPS, 2015e). 200 feet AGL to 7,500 feet MSL

Obstructions to Airspace Considerations

Several references in the Texas statutes address airspace hazards. As defined in Chapter 22 County and Municipal Airports, Section 22.001 Definitions of Title 3 Aviation, an airport hazard is "a structure, object of natural growth, or use of land that obstructs the airspace required for the flight of aircraft in landing at or taking off from an airport; or is hazardous to the landing or takeoff of aircraft at an airport" (Texas Constitution and Statutes, 2015a). An airport hazard is further defined in Section 241.012 Airport Compatible Land Use Zoning Regulations of Subchapter B Adoption of Airport Zoning Regulations in Chapter 241 Municipal and County Zoning Authority Around Airports of Title 7 Regulation of Land Use, Structures, Businesses, and Related Activities. An airport hazard (1) endangers the lives and property of users of the airport and of occupants of land in the vicinity of the airport; or (2) is an obstruction reduces the size of the area available for the landing, taking off, and maneuvering of aircraft, tending to destroy or impair the utility of the airport and the public investment in the airport" (Texas Constitution and Statutes, 2015c).

As addressed in Subchapter B of Chapter 241 in Title 7, "a permit is required before a new structure is constructed, an existing structure is substantially changed or repaired, a new use is established or an existing use is substantially changed. A permit must be obtained as well before a nonconforming structure may be replaced, rebuilt, or substantially changed or repaired; or a nonconforming object of natural growth may be replaced, substantially changed, allowed to grow higher, or replanted. (Texas Constitution and Statutes, 2015d)

15.1.8. Visual Resources

15.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features (e.g., mountain ranges, city skylines, ocean views, unique geological formations, rivers) and constructed landmarks (e.g., bridges, memorials, cultural resources, or statues) are considered visual resources. For some, cityscapes are valued visual resources, whereas others prefer natural areas. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for NEPA and NHPA compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management, "the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)" (BLM, 1985).

15.1.8.2. Specific Regulatory Considerations

Table 15.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 15.1.8-1: Relevant Texas Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Texas Government Code, Chapter 442, Texas Historical Commission	THC	Establishes the THC to administer the National Historic Preservation Act and develop and maintain the state's register of historical places in addition "[maintaining] the historic character of sites and structures entrusted to its care."
TAC, Title 31, Part 2, Ch 59, Subchapter D, Rule § 59.64	TPWD	Provides details on administration of the state parks system, requires parks in the system to have "scenic values" of the state parks, establishes State Natural Areas for "protection and stewardship of outstanding natural resources of statewide significance" for, among others, "aesthetic enjoyment," requires preservation of State Historic Sites within the parks system for "historical and aesthetic integrity."

Sources: (Texas Legislature, 2017), (TX SOS, 2017d)

In addition to state laws and regulations, in Texas local laws may apply related to visual resources. Viewsheds and scenic vistas are increasingly important to the state's towns, cities, and counties as they look to future planning.

15.1.8.3. Character and Visual Quality of the Existing Landscape

Texas is home to seven geographic regions and "widely different landscapes" from beach, rolling hills, and canyons (Travel Tex, 2015). The state includes the rugged mountain ranges of the Davis, Guadalupe, and Santiago Mountains. Additionally, the Rio Grande River runs along its border with Mexico. Texas is known for its agricultural and industrial prowess, and, as a separate country, would rank 10th in the world in gross domestic product (GDP). (World Atlas, 2015) (USGS, 2017a)

Most of Texas is characterized by pasture/range lands and croplands (Figure 15.1.7-1 in Section 15.1.7, Land Use, Recreation, and Airspace). Pasture/range lands are the state's most dominant visual resource, comprising 61 percent of total land cover in the state (USDA Economic Research Service, 2015). Their primary vegetation is herbaceous plant and shrubs for foraging livestock. Pasture is different from range in that its vegetation is introduced and propagated to provide preferred forage for grazing livestock. (NRCS, 2015g) Visual resources within pasture lands are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape. Croplands comprise 20 percent of total land cover in Texas and visual resources within them consist of either row crops, closely sown crops or fallow land awaiting planting. Crops may include hay, silage, fruit trees, berries, tree nuts, vegetables, or melons (USDA Economic Research Service, 2014). One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur. Section 15.1.7, Land Use, Recreation, and Airspace, discusses land use and contains further descriptions of land cover within the state.

While the state and many municipalities have some 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.

15.1.8.4. 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 15.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Texas, there are 3,206 NRHP listed sites, which include 1 National Memorial, 2 National Historic Trails, 1 National Historic Site, and 3 National Historical Parks. Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time (NPS, 2015g) (NPS, 2015h).

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

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the U.S. Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015i). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016b). 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 Texas, there are 46 NHLs, including sites such as Alamo, Fort Sam Houston, Palo Alto Battlefield, Roma Historic District, and Spanish Governor's Palace (see Figure 15.1.8-1) (NPS, 2015j). By comparison, there are over 2,500 NHLs in the United States, with less than 2 percent of these located in Texas (NPS, 2015i). Figure 15.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Memorial

NPS defines a National Memorial as an area that is "primarily commemorative." Texas is home to one National Memorial, Chamizal National Memorial (Figure 15.1.8-1). Chamizal National Memorial venerates the peaceful settlement of the 100-year border dispute between the United States and Mexico (NPS, 2015k). Visual resources at the memorial include a Spanish garden, migratory birds, grassy hills, mountain vistas, and the Bridge of the Americas and Mexico (NPS, 2015k).

National Historic Trails

The National Trails System Act defines National Historic Trails as "extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance" (NPS, 2012a). Two National Historic Trails pass through Texas and surrounding states: El Camino Real de los Tejas NHT and El Camino Real de Tierra Adentro NHT (Figure 15.1.8-1) (NPS, 2015g). The El Camino Real de los Tejas NHT is a 2,500 mile route that connects Mexico City to what is now Louisiana and linked cultural and linguistic groups and facilitated "cultural diffusion, biological exchange, and communication" (NPS, 2015l). The El Camino Real de Tierra Adentro NHT recounts 300 years of Southwest culture and heritage through Texas and New Mexico (NPS, 2015g).

National Historic Sites and Historical Parks

Texas has four 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 one national historic site (NHS), Fort Davis, is "one of the best surviving examples of an Indian Wars' frontier military post in the Southwest" (NPS, 2015g). The three National Historical Parks include Lyndon B. Johnson NHP, Palo Alto Battlefield NHP, and San Antonio Missions NHP (NPS, 2015g). These sites may contain aesthetic and scenic values associated with history and are identified on the map in Figure 15.1.8-1.

State Historic Sites and Museums

The Texas Historical Commission (THC) manages 20 state historic sites including Caddo Mounds, Fulton Mansion, Levi Jordan Plantation, Sam Bell Maxey House, and San Felipe de Austin (Table 15.1.8-2 and Figure 15.1.8-1) (Texas Historical Commission, 2015a).

Table 15.1.8-2: THC State Historic Sites

THC State Historic Site Name	
Acton	Landmark Inn
Caddo Mounds	Levi Jordan Plantation
Casa Navarro	Magoffin Home
Confederate Reunion Grounds	National Museum of the Pacific War
Eisenhower Birthplace	Sabine Pass Battleground
Fannin Battleground	Sam Bell Maxey House
Fort Griffin	Sam Rayburn House Museum
Fort Lancaster	San Felipe de Austin
Fort McKavett	Starr Family Home
Fulton Mansion	Varner-Hogg Plantation

Source: (Texas Historical Commission, 2015a)

Additionally, TPWD maintains 23 historic sites, including archaeological and rock art sites, historic homes and missions, forts, battlegrounds, commemorative sites, and living history sites as part of the state parks system (Table 15.1.8-3 and Figure 15.1.8-1) (TPWD, 2015y).

Table 15.1.8-3: TPWD State Historic Sites

TPWD State Historic Site Name	
Barrington Living History Farm at Washington-on-the-Brazos	Mission Espiritu Santo
Battleship *Texas*	Mission Rosario
Big Bend Ranch	Monument Hill
Caprock Canyons	Monument Hill and Kreische Brewery
Devils River	Penn Farm at Cedar Hill
Fanthorp Inn	San Jacinto Battleground
Fort Leaton	San Jacinto Monument
Fort Richardson	Sauer-Beckmann Farm at Lyndon B. Johnson
Goliad	Seminole Canyon
Hueco Tanks	Washington-on-the-Brazos
Lipantitlan	Zaragoza Birthplace
Lyndon B. Johnson	

Source: (TPWD, 2015y)

State Heritage Areas

The Texas Historical Commission (THC) maintains the Texas Heritage Trails Program in 10 heritage regions of the state to “partner and promote Texas’ historic and cultural resources” in support of its mission “to protect and preserve the state’s historic and prehistoric resources for the use, education economic benefit, and enjoyment of present and future generations” (Texas Historical Commission, 2015b).

15.1.8.5. Parks and Recreation Areas

Parks and recreation areas include state parks, National Monuments, National Parks, National Preserves, National Seashores, National Recreation Areas, National Forests, and Federal 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 15.1.7-3 in Section 15.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources in Texas. Figure 15.1.8-4 displays natural areas that may be visually sensitive, including park and recreation areas.[106]

National Park Service

National Parks are managed by the NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation. Owned by the U.S. government, these areas are maintained for the public's use. In Texas, there are 14[107] officially designated National Parks in addition to other NPS affiliated areas, such as National Heritage Areas. There are two National Monuments, two National Recreation Areas, two National Parks, one National Preserve, one National Memorial, two National Historic Trails, one National Historic Site, three National Historical Parks, one National Seashore, and one Wild & Scenic River. Table 15.1.8-4 identifies all the National Parks and affiliated areas located in Texas (Figure 15.1.8-1). For additional information regarding parks and recreation areas, see Section 15.1.7, Land Use, Recreation, and Airspace.

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[106] 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.
[107] 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.

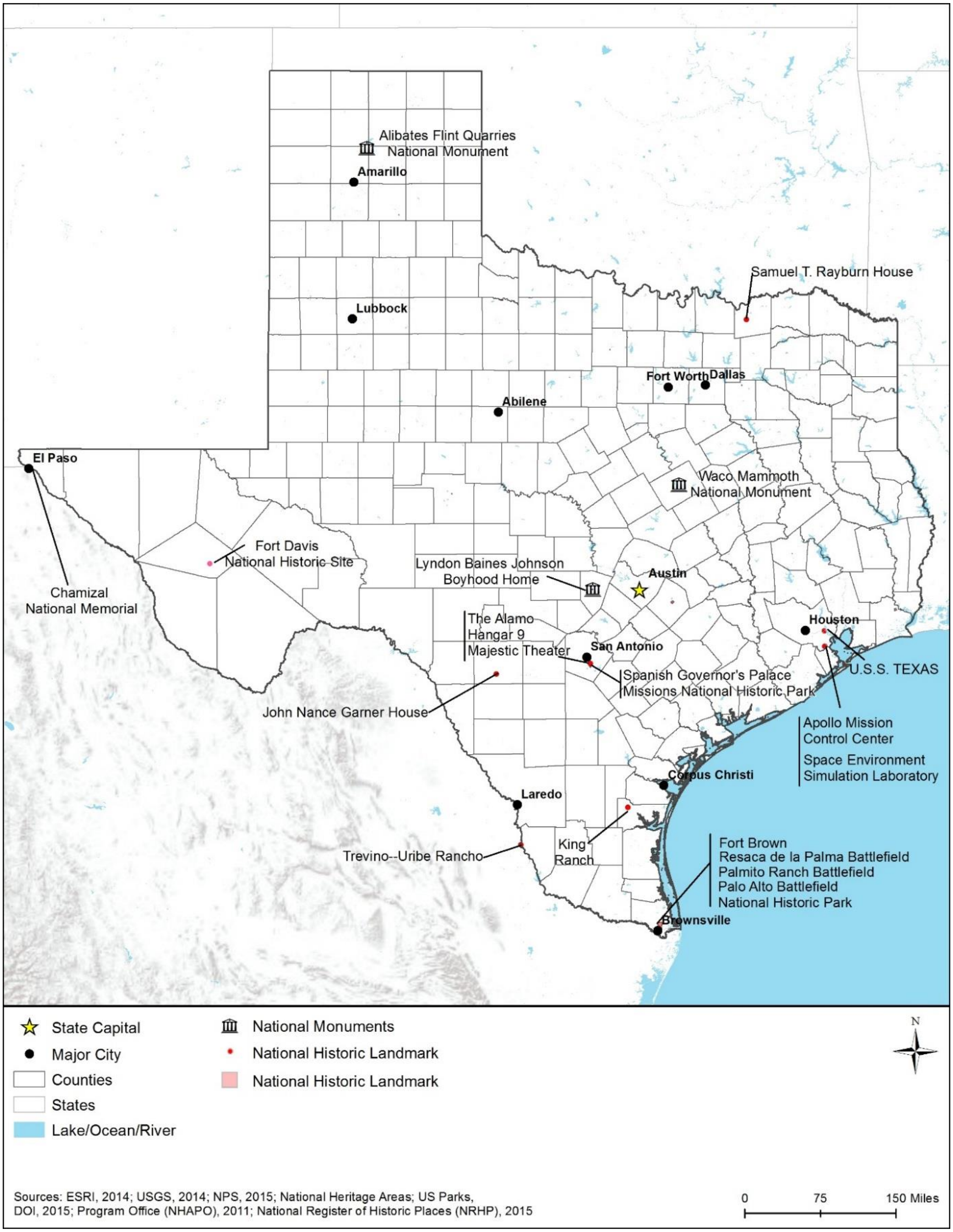


Figure 15.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

Table 15.1.8-4: Texas National Parks and Affiliated Areas

Area Name	
Alibates Flint Quarries National Monument	Guadalupe Mountains National Park
Amistad National Recreation Area	Lake Meredith National Recreation Area
Big Bend National Park	Lyndon B. Johnson National Historical Park
Big Thicket National Preserve	Padre Island National Seashore
Chamizal National Memorial	Palo Alto Battlefield National Historical Park
El Camino Real de los Tejas National Historic Trail	Rio Grande Wild & Scenic River
El Camino Real de Tierra Adentro National Historic Trail	San Antonio Missions National Historical Park
Fort Davis National Historic Site	Waco Mammoth National Monument

Source: (NPS, 2015g)

National Monument

NPS defines a national monument as a "nationally significant resource…smaller than a national park and [lacking]…diversity of attractions." Texas is home to two national monuments managed by NPS, Alibates Flint Quarries and Waco Mammoth (Table 15.1.8-4 and Figure 15.1.8-4) (NPS, 2015g).

National Parks

An NPS-designated National Park "contains a variety of resources and encompasses large land or water areas to help provide adequate protection of the resources" (NPS, 2003). There are two National Parks in Texas: Big Bend National Park and Guadalupe Mountains National Park. Big Bend NP houses a wealth of flint used to make tools by mammoth hunters over 13,000 years ago. Guadalupe Mountains National Park is a world premier example of a "fossil reef from the Permian Era" and contains visual resources such as pristine wilderness areas and birds. (NPS, 2015g)

National Preserve

A National Preserve is established by NPS "primarily for the protection of certain resources" where "activities like hunting and fishing or the extraction of minerals and fuels may be permitted if they do not jeopardize the natural values" (NPS, 2003). There is one National Preserve in Texas, Big Thicket National Preserve. Big Thicket National Preserve protects the diverse wildlife found in the habitats that come together in southeast Texas and includes resources such as longleaf pine forests, cypress-lined bayous, and abundant wildlife (National Wild and Scenic Rivers System, 2015b).

National Seashore

National Seashores are designated by NPS to "[preserve] shoreline areas and off-shore islands" and focus on the "preservation of natural values while at the same time providing water-oriented recreation" (NPS, 2003). There is one National Seashore in Texas, Padre Island National Seashore. Padre Island National Seashore "separates the Gulf of Mexico from the Laguna Madre, one of a few hypersaline lagoons in the world." It consists of 70 miles of coast, dunes, prairies and tidal flats as well as hundreds of species of birds. (National Wild and Scenic Rivers System, 2015b)

National Recreation Areas

National Recreation Areas are "lands and waters set aside for recreation use" (NPS, 2003). In Texas, there are two National Recreation Areas managed by NPS (Figure 15.1.8-4) (NPS, 2015g). The Amistad National Recreation Area is considered an oasis in the desert and includes a portion of the International Amistad Reservoir. Scenic resources include the reservoir, rock art, wildlife, and a variety of flora. The Lake Meredith National Recreation Area includes Lake Meredith, the Canadian River, dry grasslands and hidden coves. (NPS, 2015g)

Source: (NPS, 2015m)

Figure 15.1.8-2: Lake Meredith National Recreation Area

National Forests

Several agencies manage forested areas in Texas, including the USFS. There are four National Forests managed by the USFS in Texas: Angelina National Forest, Davy Crockett National Forest, Sabine National Forest, and Sam Houston National Forest (Figure 15.1.8-4) (USFS, 2015b). The Davy Crockett National Forest consists of 160,000 acres in east Texas (USFS, 2015c). The forest contains visual resources such as woodlands, streams, and wildlife. The USFS conducts inventories of the forest lands and assigns scenic resource categories from which they manage for scenic and visual resources (USDA 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USDA 1995). For additional information regarding parks and recreation areas, see Section 15.1.7, Land Use, Recreation, and Airspace.

Army Corps of Engineers Recreation Areas

There are 29 U.S. Army Corps of Engineers (USACE) recreation areas within the state, as noted in Table 15.1.8-5 (Figure 15.1.8-4) (USACE, 2015b). These lakes are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

Table 15.1.8-5: USACE Recreation Areas

Recreation Area Name	
Aquilla Lake	Lewisville Lake
Bardwell Lake	Navarro Mills Lake
Belton Lake	O.C. Fisher Lake
Benbrook Lake	Pat Mayse Lake
Buffalo Bayou	Proctor Lake
Caddo Lake	Ray Roberts Lake
Canyon Lake	Sam Rayburn Reservoir
Cooper Lake	Somerville Lake
Georgetown Lake	Steinhagen Lake
Granger Lake	Stillhouse Hollow Lake
Grapevine Lake	Truscott Brine Lake
Hords Creek Lake	Waco Lake
Joe Pool Lake	Wallisville Lake
Lake O' The Pines	Whitney Lake
Lake Texoma	Wright Patman Lake
Lavon Lake	

Source: (USACE, 2015c)

Bureau of Reclamation Recreation Areas

The Bureau of Reclamation's "multipurpose approach to water resource development" includes offering recreation areas with important natural and cultural resources (Bureau of Reclamation, 2015a). When planning for recreation, the Bureau must ensure that "potential impacts to natural and cultural resources…are taken into consideration" (Bureau of Reclamation, 2009). Visual resources in these natural areas may revolve around water sources such as lakes, canals, and reservoirs. Table 15.1.8-6 present the three Bureau of Reclamation Recreation Areas in Texas (Figure 15.1.8-4) (Bureau of Reclamation, 2015b).

Table 15.1.8-6: Texas Bureau of Reclamation Recreation Areas

Recreation Area Name	
Choke Canyon Reservoir	Twin Buttes Reservoir
Lake Meredith National Recreation Area	

Source: (Bureau of Reclamation, 2015c)

Federal and State Trails

TPWD maintains a network of trails within the state parks systems for recreational purposes, including wildlife and nature viewing, hiking, biking, and geocaching (TPWD, 2015z). Due to their locations in the state park system, these trails contain visual resources similar to those in the state park and sites on which they reside.

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 (American Trails, 2015a). In Texas, there are 27 National Recreation Trails administered by the USFWS, USACE, USFS, and local and state governments (American Trails, 2015b).

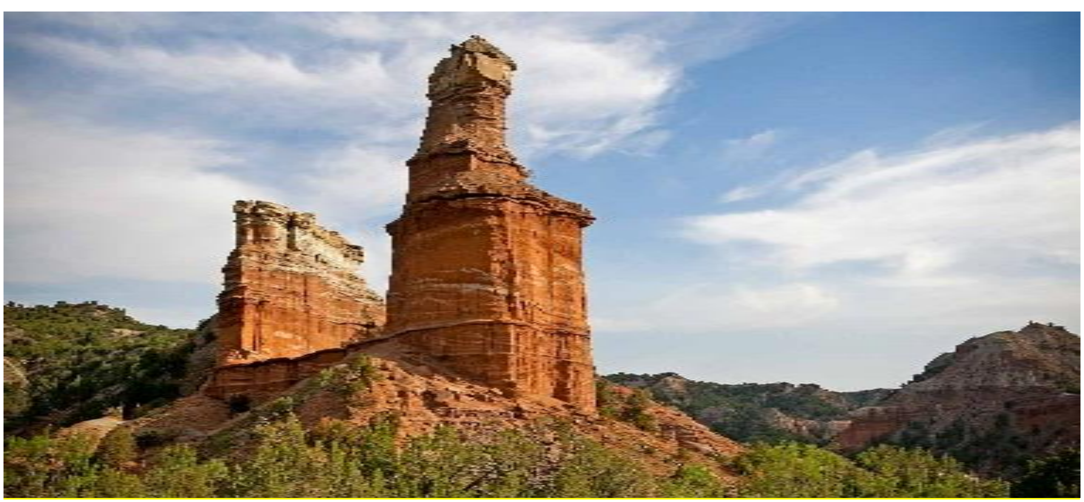
State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Texas residents and visitors. There are approximately 80 state parks in Texas, most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive. Table 15.1.8-7 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, see the TPWD website (TPWD, 2015aa).

Table 15.1.8-7: Examples of Texas State Parks and Associated Visual Attributes

State Park	Visual Attributes
Copper Breaks State Park	Grass/mesquite-covered mesas, juniper breaks, wildlife, birds, lake
Dinosaur Valley State Park	Paluxy River, isolate pools, hilly limestone terrain, wildlife, plants, dinosaur tracks
Mustang Island State Park	Barrier islands, coastal sand dunes, coastal grasses, birds, sea turtles
Palo Duro Canyon State Park	Large canyon, hoodoos[108], wildlife, birds, plants, wildflowers
Sea Rim State Park	Gulf shoreline, salt marshland, alligators, birds, wildlife, sandy beaches, lagoons, wetlands, lakes, salt-tolerant plants and brackish plants

Source: (TPWD, 2015z)



Source: (TPWD, 2015b)

Figure 15.1.8-3: Palo Duro Canyon State Park

[108] Tall, thin spire of rock that protrudes from the bottom of an arid drainage basin or badland.

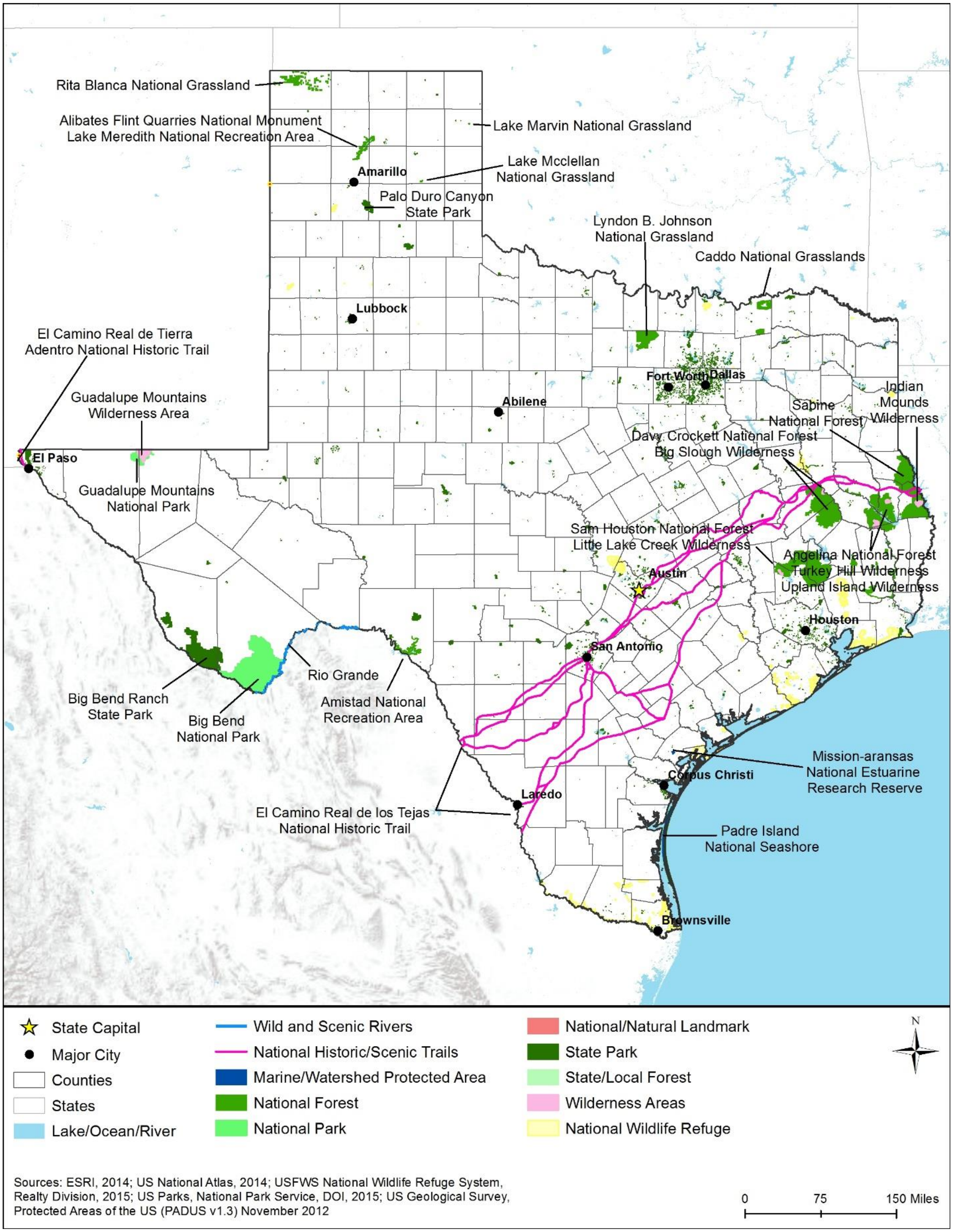


Figure 15.1.8-4: Natural Areas that May be Visually Sensitive

State Forests

The Texas A&M Forest Service "conserves and protects the resources and lands" of the state as part of a land grant college (Texas A&M Forest Service, 2015c). The Service maintains lands on five state forests and two arboretums including: E.O. Siecke State Forest, I.D. Fairchild State Forest, John Henry Kirby Memorial State Forest, Masterson State Forest, Olive Scott Petty Arboretum, Ruth Bowling Nichols Arboretum, and W. Goodrich Jones State Forest. (Texas A&M Forest Service, 2015b)

15.1.8.6. Natural Areas

The abundance of natural areas varies by state depending on the amount of public or state lands managed within each. Although many natural areas may not be managed specifically for visual resources, these areas are allowed protection for their natural resources and the resulting management protects these scenic resources. Figure 15.1.8-4 identifies natural areas that may have sensitive visual resources.

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. There are 191.2 miles of the Rio Grande River are designated National Wild and Scenic River in Texas and are managed by NPS (National Wild and Scenic Rivers System, 2015b).

National Wildlife Refuges

National Wildlife Refuges (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, 2015cs). There are 18 NWRs in Texas (Table 15.1.8-8) including the Lower Rio Grande Valley NWR (USFWS, 2015ct). This refuge is comprised of habitat where the Rio Grande River meets the Gulf of Mexico and is considered "one of the most biologically diverse regions in North America (USFWS, 2013g). Visual resources within this NWR include migratory birds, diverse plants, wildlife, saline flats, marshes, shallow bays, and lomas[109] (USFWS, 2012d).

[109] Hill or ridge having a flat top.

Table 15.1.8-8: Texas National Wildlife Refuges

National Wildlife Refuge Name	
Anahuac NWR	Laguna Atascosa NWR
Aransas NWR	Lower Rio Grande Valley NWR
Attwater Prairie Chicken NWR	McFaddin NWR
Balcones Canyonlands NWR	Muleshoe NWR
Big Boggy NWR	Neches River NWR
Brazoria NWR	San Bernard NWR
Buffalo Lake NWR	Santa Ana NWR
Caddo Lake NWR	Texas Point NWR
Hagerman NWR	Trinity River NWR

Source: (USFWS, 2015ct)

State Wildlife Management Areas and Refuges

TPWD's Wildlife Division manages 52 Wildlife Management Areas on 714,094 acres to provide opportunities for research, education, and public recreation, including hunting, hiking, camping, and bird watching (Table 15.1.8-9). For additional information on wildlife refuges and management areas, see Section 15.7, Wildlife.

Table 15.1.8-9: Texas Wildlife Management Areas and Refuges

WMA Name	
Alabama Creek WMA	Las Palomas WMA, Lower Rio Grande Valley Units
Alazan Bayou WMA	Lower Neches WMA
Angelina-Neches/Dam B WMA	M.O. Neasloney
Atkinson Island WMA	Mad Island
Bannister WMA	Mason Mountain WMA
Big Lake Bottom WMA	Matador WMA
Black Gap WMA	Matagorda Island
Caddo Lake WMA	McGillivray and Leona McKie Muse WMA
Caddo National Grasslands WMA	Moore Plantation WMA
Candy Cain Abshier WMA	Nannie M. Stringfellow
Cedar Creek Islands WMA	Nature Center
Chaparral WMA	North Toledo Bend
Cooper WMA	Old Sabine Bottom
D.R. Wintermann WMA	Pat Mayse
East Texas Conservation Center	Playa Lakes, Armstrong Unit
Elephant Mountain WMA	Playa Lakes, Dimmitt Unit
Gene Howe WMA	Playa Lakes, Taylor Lakes Unit
Gene Howe WMA - W.A. "Pat" Murphy Unit	Redhead Pond
Guadalupe Delta WMA	Richland Creek WMA
Gus Engeling WMA	Sam Houston National Forest WMA
J.D. Murphree WMA	Sierra Diablo WMA
James E. Daughtrey	Tawakoni WMA
Justin Hurst	Tony Houseman WMA
Keechi Creek WMA	Welder Flats WMA
Kerr WMA	White Oak Creek WMA
Las Palomas WMA, Anacua Unit	Yoakum Dunes WMA

Source: (TPWD, 2015ab)

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 to designate wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value." Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (44 million acres) and part of the National Park System. Designated wilderness areas are managed by the USFS, Bureau of Land Management, USFWS, and NPS (NPS, 2015n). Texas has six federally managed Wilderness Areas: Big Slough Wilderness, Guadalupe Mountains Wilderness, Indian Mounds Wilderness, Little Lake Creek Wilderness, Turkey Hill Wilderness, and Upland Island Wilderness (Figure 15.1.8-4) (Wilderness.net, 2015).

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014b). These landmarks may be considered visual resources or visually sensitive. In Texas there are 20 NNLs (Table 15.1.8-10 and Figure 15.1.8-4). Some of the natural features located within these areas include the largest remaining gulf coastal prairie, cave systems with rare speleothems,[110] and the least disturbed "natural shortgrass climax communities in the Great Plains biophysiographic province" (NPS, 2012b).

Table 15.1.8-10: Texas National Natural Landmarks

National Natural Landmarks Name	
Attwater Prairie Chicken Preserve	Greenwood Canyon
Bayside Resaca Area	High Plains Natural Area
Catfish Creek	Little Blanco River Bluff
Cave Without a Name	Longhorn Cavern
Caverns of Sonora	Lost Maples State Natural Arear
Devil's Sinkhole	Muleshoe National Wildlife Refuge
Dinosaur Valley	Natural Bridges Cavern
Enchanted Rock	Odessa Meteor Crater
Ezell's Cave	Palo Duro Canyon State Park
Fort Worth Nature Center and Refuge	Santa Ana National Wildlife Refuge

Source: (NPS, 2012b)

[110] Mineral deposits formed from groundwater within underground caverns.

Source: (NPS, 2012c)

Figure 15.1.8-5: Devil's Sinkhole

National Grasslands

Texas is home to five National Grasslands: Black Kettle, Caddo, Lyndon B. Johnson, McClellan Creek, and Rita Blanca National Grasslands (USFS, 2015d). The Caddo National Grasslands contains 17,785 acres and three lakes. The Lyndon B. Johnson National Grasslands includes 20,250 acres and has a recreation area along with a lake, hiking, and multipurpose trails (USFS, 2015e).

State Natural Areas

The TPWD Recreation Department maintains seven state natural areas (SNA) including Devil's Sinkhole SNA, Devil's River SNA, Enchanted Rock SNA, Government Canyon SNA, Hill Country SNA, Honey Creek SNA, and Lost Maples SNA (TPWD, 2015ac). Government Canyon SNA contains rugged canyon lands and gently rolling grasslands along with wildlife and birds. This SNA is also home to 110 million year old dinosaur footprints (TPWD, 2015ad). Additionally, natural and conservation areas also include 29 properties owned and managed in cooperation with private land owners, TPWD, USFWS, Texas A&M Forest Service, U.S. Army, and The Nature Conservancy. These properties include Cibolo Bluffs Preserve, Dolan Falls Preserve, Eckert James River Bat Cave Preserve, Lennox Woods Preserve, and Yoakum Dunes Preserve (The Nature Conservancy, 2015a). Eckert James River Bat Cave Preserve contains one of the largest bat nurseries in the country and the cave where the roost (The Nature Conservancy, 2015b).

15.1.8.7. 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. Texas has no designated National Scenic Byways (FHWA, 2015c).

The Texas Heritage Trails Program is based on 10 scenic driving trails originally created by the Texas Highway Department (now TxDOT and then Governor, John Connally) (Table 15.1.8-11). Each scenic driving trail meanders through one of the 10 heritage regions in the state (Texas Historical Commission, 2015b).

Table 15.1.8-11: Texas Heritage Scenic Driving Trails

Scenic Driving Trail Name	
Brazos Trail	Lakes Trail
Forest Trail	Mountain Trail
Forts Trail	Pecos Trail
Hill Country Trail	Plains Trail
Independence Trail	Tropical Trail

Source: (Texas Historical Commission, 2015b)

15.1.9. Socioeconomics

15.1.9.1. 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. The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet *may affect*.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order 12898. This PEIS addresses environmental justice in a separate section (Section 15.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 15.1.7, Land Use, Recreation, and Airspace), infrastructure and public services (Section 15.1.1, Infrastructure), and aesthetic considerations (Section 15.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau[111] (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 local taxes.

[111] 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.

15.1.9.2. 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.

15.1.9.3. Communities and Populations

This section discusses the population and major communities of Texas (TX) 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 15.1.9-1 presents the 2014 population and population density of Texas in comparison to the South region[112] and the nation. The estimated population of Texas in 2014 was 26,956,958. The population density was 103 persons per square mile (sq. mi.), which was lower than the population density of the region (114 persons/sq. mi.) and higher than the nation's density (90 persons/sq. mi.). In 2014, Texas was the second largest state by population among the 50 states and the District of Columbia, second largest by land area, and had the 27th greatest population density (U.S. Census Bureau, 2014; U.S. Census Bureau, 2010a).

Table 15.1.9-1: Land Area, Population, and Population Density of Texas

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Texas	261,232	26,956,958	103
South Region	914,471	104,109,977	114
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2014; U.S. Census Bureau, 2010a)

Population growth is an important subject for this PEIS given FirstNet's mission. Table 15.1.9-2 presents the population growth trends of Texas from 2000 to 2014 in comparison to the South region and the nation. The state's annual growth rate decreased from 1.89 percent to 1.75 percent in the 2010 to 2014 period compared to 2000 to 2010. The growth rate of Texas in the 2010 to 2014 period was considerably higher than the growth rate of the region (1.14 percent) and the nation (0.81 percent).

[112] The South region is comprised of the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, New Mexico, North Carolina, 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 15.1.9-2: Recent Population Growth of Texas

Geography	Population			Numerical Population Change		Rate of Population Change (AARC)[a]	
	2000	2010	2014 (estimated)	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Texas	20,851,820	25,145,561	26,956,958	4,293,741	1,811,397	1.89%	1.75%
South Region	86,516,862	99,487,696	104,109,977	12,970,834	4,622,281	1.41%	1.14%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

Sources: (U.S. Census Bureau, 2000a; U.S. Census Bureau, 2014)
[a] AARC = Average Annual Rate of Change (compound growth rate)

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use population projections that apply the same methodology across the nation. It is also useful to consider projections that use different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 15.1.9-3 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 (NOAA, 2014d) (UVA Weldon Cooper Center, 2015). The table provides figures for numerical change, percentage change, and annual growth rate based on averaging the projections from the two sources. The average projection indicates Texas' population will increase by approximately 5.1 million people, or 19.0 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 1.09 percent, which is considerably lower than the historical growth rate from 2010 to 2014. The projected growth rate of the state is higher than that of the region (0.97 percent) and the nation (0.80 percent).

Table 15.1.9-3: Projected Population Growth of Texas

Geography	Population 2014 (estimated)	Projected 2030 Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC)[a] 2014 to 2030
Texas	26,956,958	32,194,206	31,972,276	32,083,241	5,126,283	19.0%	1.09%
South Region	104,109,977	122,323,551	120,794,020	121,558,786	17,448,809	16.8%	0.97%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

Sources: (U.S. Census Bureau, 2014; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)
[a] AARC = Average Annual Rate of Change

Population Distribution and Communities

Figure 15.1.9-1 presents the distribution and relative density of the population of Texas. 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, 2013a).

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, 2010b; U.S. Census Bureau, 2010c). 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. The western half of Texas is much less densely populated than the eastern half. The very sparsely populated area in the western region of the state is the only mountainous part of the state, which includes peaks, wooded mountain slopes, sand hills, desert valleys, and desert grasslands. For more information about this area, see the discussion of the Big Bend Region in Section 15.1.7, Land Use, Recreation, and Airspace.

Table 15.1.9-4 provides the populations of the 10 largest population concentrations in Texas, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[113] In 2010, the two largest population concentrations were the Dallas/Fort Worth/Arlington and Houston areas, which had approximately 5 million people each. The state had two other population concentrations over a million (Austin and San Antonio areas). The smallest of these 10 population concentrations was the Lubbock area, with a 2010 population of 237,356. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Conroe/The Woodlands area, with an annual growth rate of 6.25 percent. However, this area had a large increase in its area definition that may have taken in some existing populations; thus, the growth rate may reflect this factor as well as organic growth (net in-migration and/or births exceeding deaths).

Table 15.1.9-4 also shows that the top 10 population concentrations in Texas accounted for 63.0 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 82.8 percent of the entire state's growth.

[113] 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.

15.1.9.4. 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 15.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 15.1.9-5 compares several economic indicators for Texas to the South region and the nation. The table presents two indicators of income[114] – 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 15.1.9-5, the per capita income in Texas in 2013 ($26,327) was $1,316 higher than that of the region ($25,011), and $1,857 lower than that of the nation ($28,184).

[114] 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, 2015f).

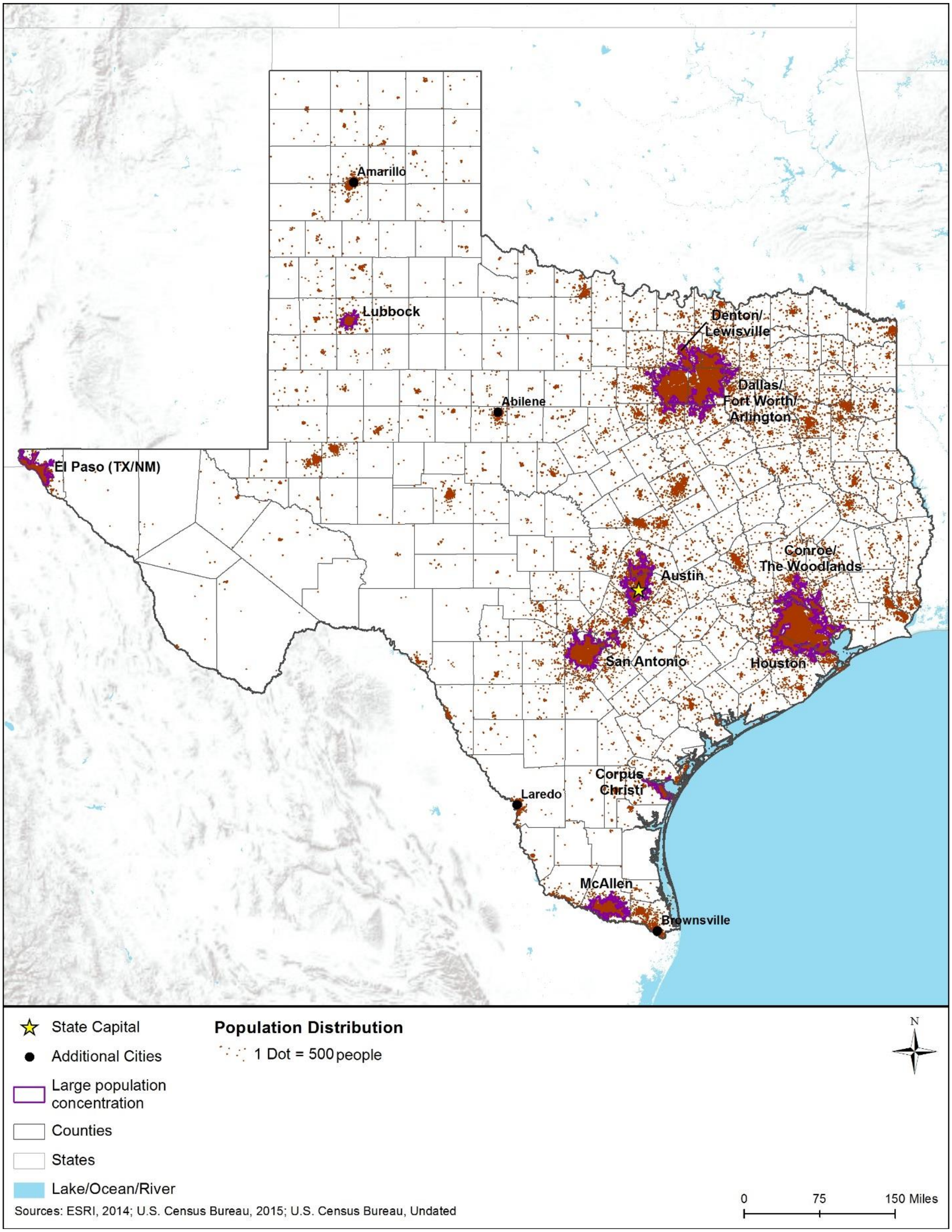


Figure 15.1.9-1: Population Distribution in Texas, 2009–2013

Table 15.1.9-4: Population of the 10 Largest Population Concentrations in Texas

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)[a]
Austin	901,920	1,362,416	1,421,159	4	460,496	4.21%
Conroe/The Woodlands[b]	130,847	239,938	254,955	9	109,091	6.25%
Corpus Christi	293,925	320,069	324,508	8	26,144	0.86%
Dallas/Fort Worth/Arlington	4,145,659	5,121,892	5,235,068	1	976,233	2.14%
Denton/Lewisville	299,823	366,174	377,076	7	66,351	2.02%
El Paso (TX/NM) (TX Portion)	648,465	772,374	778,719	5	123,909	1.76%
Houston	3,822,509	4,944,332	5,067,551	2	1,121,823	2.61%
Lubbock	202,225	237,356	239,294	10	35,131	1.61%
McAllen	523,144	728,825	735,412	6	205,681	3.37%
San Antonio	1,327,554	1,758,210	1,798,985	3	430,656	2.85%
Total for Top 10 Population Concentrations	**12,296,071**	**15,851,586**	**16,232,727**	**NA**	**3,555,515**	**2.57%**
Texas (statewide)	**20,851,820**	**25,145,561**	**25,639,373**	**NA**	**4,293,741**	**1.89%**
Top 10 Total as Percentage of State	**59.0%**	**63.0%**	**63.3%**	**NA**	**82.8%**	**NA**

Sources: (U.S. Census Bureau, 2010b; U.S. Census Bureau, 2000b; U.S. Census Bureau, 2013b)

[a] AARC = Average Annual Rate of Change
[b] The 2000 population presented here is the sum of populations for the Conroe urban cluster and The Woodlands urbanized area. Also, the large population increase from 2000 to 2010 reflects a large change in the area definition for the Conroe/The Woodlands area, from 67 sq. mi. in 2000 (summed areas for Conroe and The Woodlands) to 133 sq. mi. in 2010.
NA = Not Applicable

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 15.1.9-5 shows that in 2013, the MHI in Texas ($51,714) was $5,152 higher than that of the region ($46,562), and $536 lower than that of the nation ($52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 15.1.9-5 compares the unemployment rate in Texas to the South region and the nation. In 2014, Texas' statewide unemployment rate of 5.1 percent was lower than both the rate for the region (6.1 percent) and the nation (6.2 percent).[115]

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

Table 15.1.9-5: Selected Economic Indicators for Texas

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Texas	$26,327	$51,704	5.1%
South Region	$25,011	$46,562	6.1%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015b; U.S. Census Bureau, 2013c; U.S. Census Bureau, 2013d; U.S. Census Bureau, 2013e)

Figure 15.1.9-2 and Figure 15.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2013c) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 15.1.9-1 (U.S. Census Bureau, 2010b; U.S. Census Bureau, 2010c). Following these two maps, Table 15.1.9-6 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 Texas.

Figure 15.1.9-2 shows that, at the county level, MHI in 2013 had a variable distribution across the state, with high and low MHI levels occurring throughout the state. Relatively few counties had MHI values above the national average. The counties classified as having the lowest MHI levels were distributed throughout the state. Table 15.1.9-6 shows that the 2009–2013 MHI in the 10 largest population concentrations ranged from $34,293 (McAllen area) to $73,052 (Conroe/The Woodlands area); the state figure was $51,900. Half of the areas were above the state figure, and half below.

Figure 15.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that the great majority of counties had unemployment rates below the national average (that is, better employment performance). Only a small number of counties had unemployment rates above the national average. Table 15.1.9-6 shows that the 2009–2013 unemployment rates in the 10 largest population concentrations ranged from 5.6 percent (Conroe/The Woodlands area) to 10.7 percent (McAllen area); the state average was 8.1 percent.

Detailed employment data provide useful insights into the nature of a local, state, or national economy. Table 15.1.9-7 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 in Texas was similar to that in the South region and the nation. The percentage of government workers was lower in the state than in the region and nation. The percentage of self-employed workers in Texas was higher than in the region and nation.

By industry, Texas has a mixed economic base and some notable figures in the table are as follows. Texas in 2013 had a somewhat higher percentage of persons working in "agriculture, forestry, fishing and hunting, and mining" and in "construction" than did the region and nation. The state had a somewhat lower percentage of persons in "manufacturing" and "educational services, and health care and social assistance" than the nation. The rest of the values for Texas were within one percentage point of the region and nation.

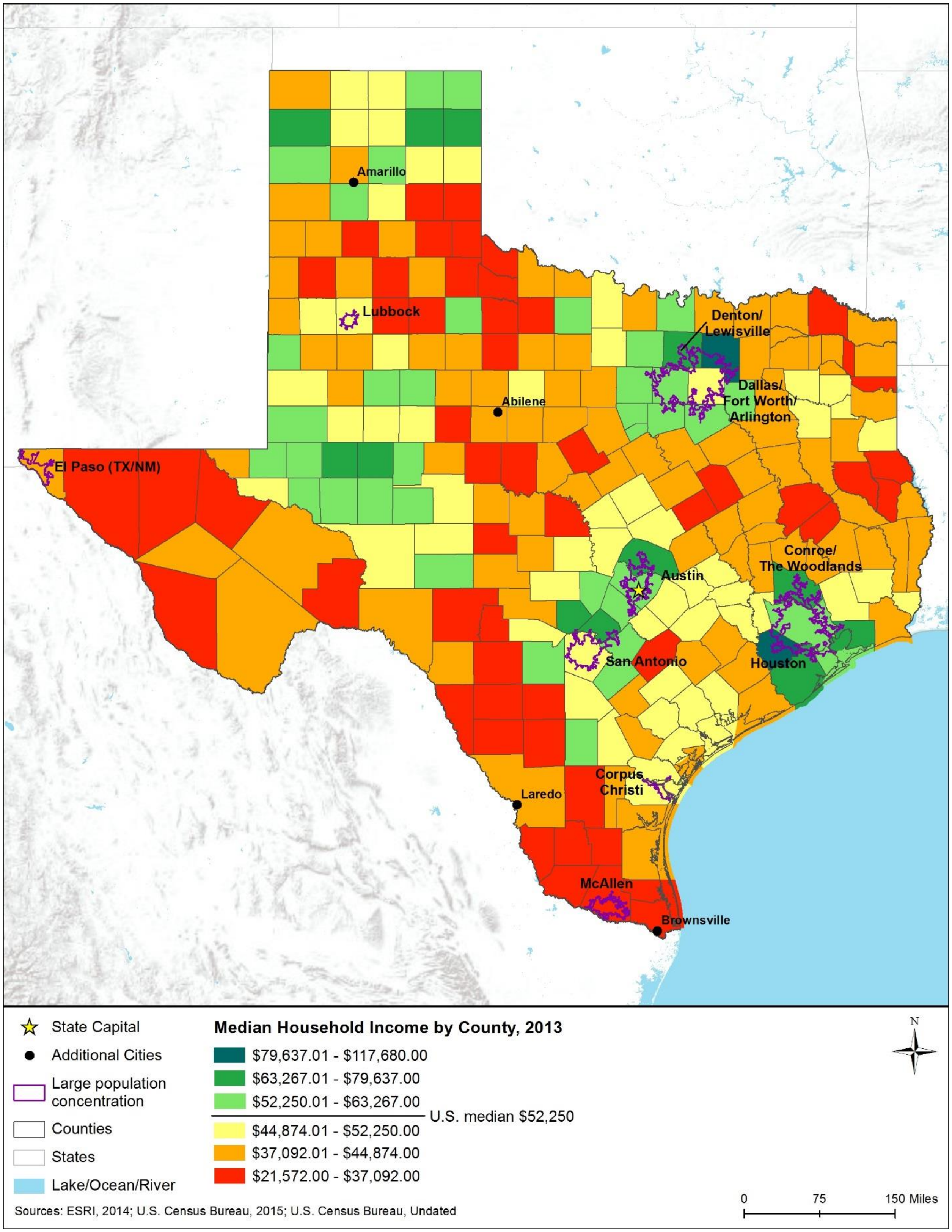


Figure 15.1.9-2: Median Household Income in Texas, by County, 2013

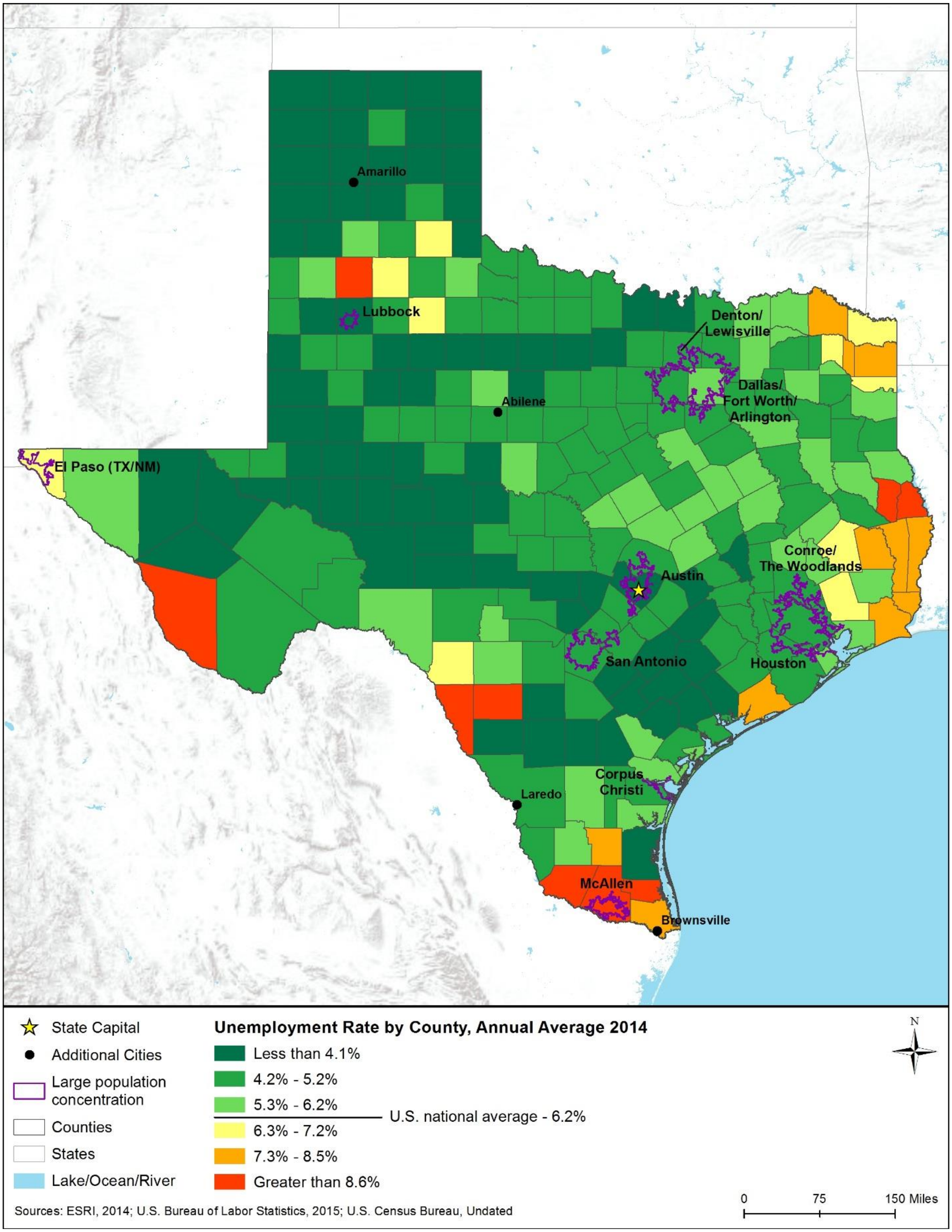


Figure 15.1.9-3: Unemployment Rates in Texas, by County, 2014

Table 15.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Texas, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Austin	$61,875	7.4%
Conroe/The Woodlands	$73,052	5.6%
Corpus Christi	$48,482	7.9%
Dallas/Fort Worth/Arlington	$56,605	8.3%
Denton/Lewisville	$72,647	6.9%
El Paso (TX/NM) (TX Portion)	$39,909	9.0%
Houston	$57,190	8.1%
Lubbock	$43,698	6.9%
McAllen	$34,293	10.7%
San Antonio	$50,899	8.1%
Texas (statewide)	$51,900	8.1%

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

Table 15.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Texas	South Region	United States
Civilian Employed Population 16 Years and Over	12,074,980	45,145,155	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.8%	79.4%	79.7%
Government workers	13.5%	14.5%	14.1%
Self-employed in own not incorporated business workers	6.6%	5.9%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	3.5%	2.4%	2.0%
Construction	7.8%	6.9%	6.2%
Manufacturing	9.3%	9.9%	10.5%
Wholesale trade	3.1%	2.8%	2.7%
Retail trade	11.6%	12.1%	11.6%
Transportation and warehousing, and utilities	5.2%	5.2%	4.9%
Information	1.8%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	6.6%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	11.1%	10.5%	11.1%
Educational services, and health care and social assistance	21.3%	22.0%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.0%	9.9%	9.7%
Other services, except public administration	5.4%	5.2%	5.0%
Public administration	4.3%	4.8%	4.7%

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

Table 15.1.9-8 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 15.1.9-7 for 2013.

Table 15.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Texas, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Austin	7.1%	2.8%	2.7%	15.2%
Conroe/The Woodlands	6.5%	6.6%	1.3%	12.2%
Corpus Christi	7.8%	5.1%	1.7%	8.3%
Dallas/Fort Worth/Arlington	7.4%	5.9%	2.6%	12.8%
Denton/Lewisville	4.8%	5.4%	2.8%	13.7%
El Paso (TX/NM) (TX Portion)	6.5%	6.5%	2.4%	9.4%
Houston	9.0%	6.0%	1.5%	12.9%
Lubbock	6.0%	3.4%	1.9%	8.2%
McAllen	7.7%	4.8%	1.3%	8.3%
San Antonio	7.1%	4.2%	2.0%	10.9%
Texas (statewide)	7.9%	5.4%	1.8%	10.8%

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

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 15.1.9-9: Selected Housing Indicators for Texas, 2013 compares Texas to the South region and nation on several common housing indicators.

As shown in Table 15.1.9-9, in 2013, Texas had a higher percentage of housing units that were occupied (88.8 percent) than the region (85.2 percent) or nation (87.6 percent). Of the occupied units, Texas had a lower percentage of owner-occupied units (61.8 percent) than the region (64.6 percent) or nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Texas in 2013 (65.0 percent) was higher than the region (63.8 percent) and the nation (61.5 percent). The homeowner vacancy rate in Texas (1.6 percent) was lower than the rate for the region (2.2 percent) and the nation (1.9 percent). This rate reflects "vacant units that are 'for sale only'" (U.S. Census Bureau, 2015d). The vacancy rate among rental units in Texas (7.9 percent) was lower than in the region (8.5 percent) and higher than in the nation (6.5 percent).

Table 15.1.9-9: Selected Housing Indicators for Texas, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Texas	10,256,203	88.8%	61.8%	1.6%	7.9%	65.0%
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, 2013h)

Table 15.1.9-10 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 15.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Texas, 2009–2013

Area	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Austin	574,917	93.1%	55.0%	1.6%	5.4%	57.9%
Conroe/The Woodlands	94,290	92.6%	67.8%	1.1%	10.0%	69.1%
Corpus Christi	130,989	89.4%	57.5%	1.8%	6.7%	66.6%
Dallas/Fort Worth/Arlington	2,044,563	91.5%	58.6%	1.8%	9.9%	62.1%
Denton/Lewisville	141,397	93.6%	62.4%	1.0%	5.9%	64.6%
El Paso (TX/NM) (TX Portion)	263,577	93.2%	61.2%	1.7%	6.5%	67.8%
Houston	1,923,483	89.6%	59.8%	2.0%	11.1%	61.0%
Lubbock	99,420	90.6%	55.7%	1.5%	7.8%	66.1%
McAllen	235,989	86.7%	67.6%	2.1%	6.1%	65.6%
San Antonio	686,833	90.8%	59.7%	1.9%	8.6%	68.0%
Texas	10,070,703	88.2%	63.3%	2.0%	9.2%	65.5%

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

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 15.1.9-11 provides indicators of residential property values for Texas 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, 2013h).

The table shows that the median value of owner-occupied units in Texas in 2013 ($132,000) was lower than the corresponding values for the South region ($137,752) and the nation ($173,900).

Table 15.1.9-11: Residential Property Values in Texas, 2013

Geography	Median Value of Owner-Occupied Units
Texas	$132,000
South Region	$137,752
United States	$173,900

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

Table 15.1.9-12 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. The median property value for these 10 communities ranged from $79,200 in the McAllen area to $199,500 in the Austin area; the statewide median value was $128,900. The lowest property value was in the area – McAllen – that had the lowest median household income (Table 15.1.9-6).

Table 15.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Texas, 2009–2013

Area	Median Value of Owner-Occupied Units
Austin	$199,500
Conroe/The Woodlands	$187,000
Corpus Christi	$114,400
Dallas/Fort Worth/Arlington	$146,600
Denton/Lewisville	$190,200
El Paso (TX/NM) (TX Portion)	$112,000
Houston	$141,300
Lubbock	$111,700
McAllen	$79,200
San Antonio	$128,300
Texas (statewide)	$128,900

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

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[116] are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

Table 15.1.9-13 shows that state government in Texas received less total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Texas received slightly more total revenue in 2012 on a per capita basis than their counterpart governments in the region and less than counterparts in the nation. State and local governments in Texas had lower levels per capita of intergovernmental revenues[117] from the federal government than their counterpart governments in the region and nation. The state government reported no revenue from property taxes. Texas local governments obtained more revenue per capita from property taxes than their counterpart governments in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

General sales taxes on a per capita basis were higher for the Texas state government than for its counterparts in the region and nation. Local governments in Texas reported similar revenue from general sales taxes as counterpart governments in the region and the nation. Selective sales taxes on a per capita basis were slightly higher for the Texas state government, and slightly lower for local governments, when compared to counterpart governments in the region and nation. The state government in Texas reported less per capita revenue from public utility taxes than its counterparts in the region and nation. Local governments in Texas reported revenue from public utility taxes similar to their counterpart governments in the region and nation. The state and local governments in Texas reported no revenue from individual or corporate income taxes.

[116] Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006).
[117] Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

Table 15.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue		Texas		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	($M)	$130,720	$120,276	$524,374	$449,683	$1,907,027	$1,615,194
	Per capita	$5,016	$4,615	$5,148	$4,414	$6,075	$5,145
Intergovernmental from Federal	($M)	$37,311	$4,259	$160,706	$18,171	$514,139	$70,360
	Per capita	$1,432	$163	$1,578	$178	$1,638	$224
Intergovernmental from State	($M)	$0	$28,911	$0	$115,088	$0	$469,147
	Per capita	$0	$1,109	$0	$1,130	$0	$1,495
Intergovernmental from Local	($M)	$674	$0	$2,815	$0	$19,518	$0
	Per capita	$26	$0	$28	$0	$62	$0
Property Taxes	($M)	$0	$40,310	$2,073	$109,687	$13,111	$432,989
	Per capita	$0	$1,547	$20	$1,077	$42	$1,379
General Sales Taxes	($M)	$24,501	$6,048	$82,651	$25,836	$245,446	$69,350
	Per capita	$940	$232	$811	$254	$782	$221
Selective Sales Taxes	($M)	$12,931	$1,889	$41,447	$9,394	$133,098	$28,553
	Per capita	$496	$72	$407	$92	$424	$91
Public Utilities Taxes	($M)	$620	$1,226	$5,101	$4,745	$14,564	$14,105
	Per capita	$24	$47	$50	$47	$46	$45
Individual Income Taxes	($M)	$0	$0	$38,637	$1,226	$280,693	$26,642
	Per capita	$0	$0	$379	$12	$894	$85
Corporate Income Taxes	($M)	$0	$0	$8,099	$114	$41,821	$7,210
	Per capita	$0	$0	$80	$1	$133	$23

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

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

15.1.10. Environmental Justice

15.1.10.1. 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, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations).[118] The fundamental principle of environmental justice as stated in the EO 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” (Executive Office of the President, 1994). Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and

[118] See https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice.

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 National Environmental Policy Act (NEPA)* to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, the USEPA's Office of Environmental Justice (USEPA, 2015f) offers guidance on Environmental Justice issues and provides an "environmental justice screening and mapping tool," EJSCREEN (USEPA, 2015g).

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

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

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

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

The policy includes accountability for the implementation of the policy, a definitions section, and an appendix that contains a list of implementation tools available. (USEPA, 2014a)

15.1.10.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to environmental justice for this PEIS. The state of Texas has not established an environmental justice policy. However, the Texas Commission on Environmental Quality (TCEQ) has established a program to address environmental justice. The goals of the Environmental Equity Program are to:

- Help citizens and neighborhood groups participate in regulatory processes;
- Serve as the agency contact to address allegations of environmental injustice;
- Serve as a link for communications between the community, industries, and the government; and
- Thoroughly consider all citizens' concerns and handle them fairly.(TCEQ, 2015m)

Federal laws relevant to environmental justice are described in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

15.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 15.1.10-1 presents 2013 data on the composition of Texas' population by race and by Hispanic origin. The state's population has lower percentages of individuals who identify as Black/African American (11.9 percent) than the populations of the region (18.4 percent) and the nation (12.6 percent). The state's population has higher percentages of individuals who identify as Asian (4.1 percent) than the populations of the South region (2.6 percent) and slightly lower percentages than the populations of the nation (5.1 percent). The state's population has higher percentages of individuals who identify as Some Other Race (6.0 percent) than the populations of the region (3.3 percent) and the nation (4.7 percent). The state's population of persons identifying as White (75.0 percent) is slightly higher than that of the South region (72.3 percent) or the nation (73.7 percent).

The percentage of the population in Texas that identifies as Hispanic (38.4 percent) is considerably larger 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. Texas' All Minorities population percentage (56.1 percent) is considerably higher than that of the South region (42.3 percent) and the nation (37.6 percent).

Table 15.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Texas (17.5 percent) is slightly lower than that for the South region (18.2 percent) and higher than that for the nation (15.8 percent).

Table 15.1.10-1: Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities[a]
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Texas	26,448,193	75.0%	11.9%	0.4%	4.1%	0.1%	6.0%	2.4%	38.4%	56.1%
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, 2013j)

[a] "All Minorities" is defined as all persons other than Non-Hispanic White.

Table 15.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Texas	17.5%
South Region	18.2%
United States	15.8%

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

15.1.10.4. 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 110 in Socioeconomics for further information on how data was calculated.)

Figure 15.1.10-1 visually portrays the results of the environmental justice population screening analysis for Texas. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2013a; U.S. Census Bureau, 2013l; U.S. Census Bureau, 2013m; U.S. Census Bureau, 2013n) and Census Bureau urban classification data (U.S. Census Bureau, 2010b; U.S. Census Bureau, 2010c)

Figure 15.1.10-1 shows that a high proportion of Texas has High Potential for environmental justice populations. The distribution of these High Potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. However, a higher proportion of counties along or near the state's southwestern border, the international border shared with Mexico, have High Potential for environmental justice populations. The distribution of areas with Moderate Potential for environmental justice populations is also fairly even across the state, excepting the southwestern border area.

It is important to understand how the data behind Figure 15.1.10-1 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 15.1.10-1 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 B, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful or significant (according to significance criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 15.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

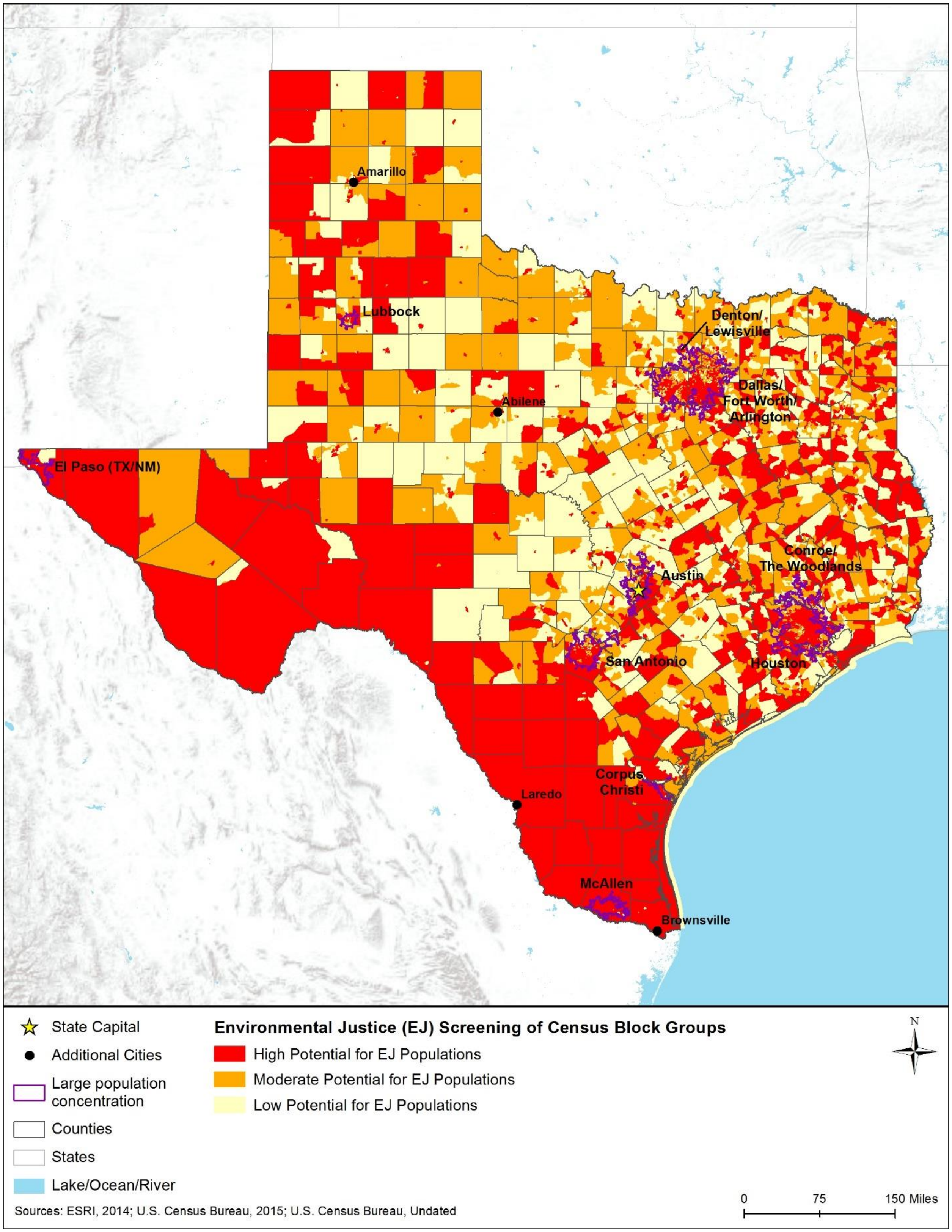


Figure 15.1.10-1: Potential for Environmental Justice Populations in Texas, 2009–2013

15.1.11. Cultural Resources

15.1.11.1. Definition of Resource

For the purposes of this PEIS, Cultural Resources are defined as:

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

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

- Statutory language and implementing regulations for Section 106 of the NHPA, 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, 2015q); and the
- 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).

15.1.11.2. Specific Regulatory Considerations

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.

Texas has a state law and related regulations that parallels the NHPA (refer to Table 15.1.11-1). However, federal regulations supersede these 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 15.1.11-1: Relevant Texas Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Antiquities Code of Texas	THC	Requires state and local government entities to notify the THC of ground disturbing activities on public lands.
Texas State Burial Site Statutes, Texas Code 191 and 711.004	THC 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 THC may assist the project proponent, developer, and/or landowner in contacting appropriate parties, considering options to avoid the burial(s), and advising on the legal process for potentially moving the remains.

Sources: (Texas Historical Commission, 2017), (Texas Legislature, 2013), (Texas Legislature, 1987)

15.1.11.3. Cultural and Natural Setting

Human beings have lived in the Texas region for at least 11,200 years (Turner, 2010). The majority of evidence of early human habitation comes from the study of archeological sites of pre-European contact and historic populations. Evidence at most archeological sites in Texas is found in relatively shallow deposits, within one to two feet of the surface. However, in some cases, natural factors have buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers and peat deposits in wetlands. These deposits can range between 1 and 10 feet below the current surface, with older sites in the deeper sediments. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas (Harris, 1979).

In addition to the 800 archaeological sites listed in the state's inventory, there are 280 archaeological sites in Texas on the NRHP (NPS, 2014c). Archaeologists typically divide large study areas into regions. Texas has three major physiographic regions: Atlantic Plain (Coastal Plain Province), Interior Plains (Central Lowland and Great Plains Provinces), and Intermontane Plateau (Basin and Range Province). The locations of these regions are shown in Figure 15.1.3-1 of this document.

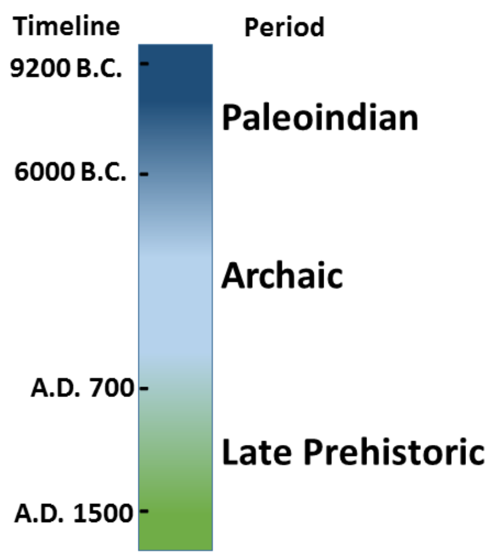
The following sections provide additional detail about Texas' prehistoric periods (approximately 9200 B.C. to A.D. 1500) and the historic period since European colonization. Section 15.1.11.4 presents an overview of the initial human habitation in Iowa and the cultural development that occurred before European contact. Section 15.1.11.5 discusses the federally recognized American Indian Tribes with a cultural affiliation to the state. Section 15.1.11.6 provides a current list of significant archaeological sites in South Dakota and tools that the state has developed to ensure their preservation. Section 15.1.11.7 documents the historic context of the state since European contact, and Section 15.1.11.8 summarizes the architectural context of the state during the historic period.

15.1.11.4. Prehistoric Setting

The prehistoric periods in Texas are composed of the Paleoindian Period (9200 – 6,000 B.C.), the Archaic Period (6,000 B.C. – A.D. 700), and the Late Prehistoric Period (A.D. 700 – 1519).

Paleoindian Period (9,200 – 6,000 B.C.)

The Paleoindian Period represents the earliest human habitation of the Texas region. The earliest people lived in small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear projectile points (Clovis or Folsom projectile point). Studies show that that similar technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002). During the Paleoindian Period, many large mammals that are now extinct, such as giant bison, mammoths, and ground sloths were hunted. The Miami site, in Roberts County, is an example of a Paleoindian mammoth kill-site. As the technologies changed and the large animals decreased in numbers at the end of the Pleistocene (around 8,000 B.C.), people began to supplement their diets with smaller game and wild plants (Turner, 2010).



Sources: (Institute of Maritime History, 2015; Pauketat, 2012)

Figure 15.1.11-1: Timeline of Prehistoric Human Occupation

Most of the oldest evidence of human settlement in Texas comes from the discovery of Clovis and Folsom fluted spear points. Among the oldest known archaeological sites from this period is the Gault Site, first discovered in 1929, in Bell County and which has yielded both Clovis points and engraved limestone cobbles. At the end of the Pleistocene, the nomadic settlement patterns and stone-tool making of the Early Paleoindian Period continued, but the types of points increased and diversified in the Late Paleoindian Period (Turner, 2010). The Wilson-Leonard Site, in southern Williamson County, contains an assemblage of artifacts that span from early evidence of Clovis habitation through the Late Archaic (Weir, 2010).

Archaic Period (6,000 B.C. – A.D. 700)

The Archaic Period in Texas is notable for "changes in the style of projectile points and tools, the distribution of site types, and the introduction of grinding implements and ground-stone ornaments" (Turner, 2010). These technology changes and improvements indicate an increasing population that exploited plant and animal species in a climate very similar to the present. Settlement patterns in the Early Archaic continued to be scattered and nomadic, although there is evidence of interaction between regions (including modern-day Oklahoma and parts of Arkansas), as evidenced by the distribution of similar projectile points (Turner, 2010).

The Middle Archaic in Texas is marked by an increase in population, based on the number of sites and artifacts dating to this period. Task-specific sites began to appear at this time, including evidence of burned-rock middens[119] for plant cooking, and coastal shell middens. Cemeteries with large numbers of burials occurred during this period, and there is continued evidence of trade with other regions (Turner, 2010).

Hunting and gathering continued across Texas during the Late Archaic, with bison as an important source of food. Village sites first appeared during the Late Archaic, although they were not fully developed until the Late Prehistoric Period. The George C. Davis Site, in Cherokee County, Texas, consists of three large earthen mounds and a portion of a prehistoric village. The site is associated with the Caddoan people, who flourished beginning around 1000 B.C. (Standifer, 2013). The earliest pottery in Texas began to appear around 500 B.C.; these early ceramic examples include those made with bone, clay, and sand-tempered pastes, to help make the vessel walls sturdier for regular use and transport (Lebo, 2010).

Late Prehistoric Period (A.D. 700 – 1500)

The Late Prehistoric Period saw the introduction of the bow and arrow, "along with other distinctive types of stone tools" (Turner, 2010). The pottery technology developed during the Late Archaic was further developed and used even by nomadic hunter-gatherers. Five prehistoric pottery regions existed in Texas (Northeast and North Central, Southeast, Central and South, High Plains, and West); crossovers in materials and techniques indicate interaction and trade between the areas (Lebo, 2010).

Although hunting and gathering remained the predominant form of subsistence in the Late Prehistoric Period, cultural differences emerged among the various inhabitant groups in Texas. Agriculture was present in east Texas, settled villages were present in the Panhandle area, and other agricultural, ceremonial mounds, and settlement centers existed in various places throughout the state during this period (Turner, 2010).

[119] Dumps for domestic waste.

15.1.11.5. Federally Recognized Tribes of Texas

According to the Bureau of Indian Affairs and the National Conference of State Legislators, the state of Texas has three federally-recognized tribes: the Alabama-Coushatta Tribe, the Kickapoo Traditional Tribe of Texas, and the Ysleta Del Sur Pueblo of Texas (National Conference of State Legislators, 2015; USGPO, 2015). The general location of the tribes are shown in Figure 15.1.11-2. Additionally, the figure depicts 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.

15.1.11.6. Significant Archaeological Sites of Texas

As previously mentioned in Section 15.1.11.3, there are 800 archaeological sites in Texas, 280 of which are listed on the NRHP. Table 15.1.11-2 lists the names of the NRHP archaeological sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NPS NRHP website (NPS, 2014d).

Texas State Cultural Resources Database and Tools

Texas Historical Commission (THC)

The Texas Historical Commission fulfills the duties of the State Historic Preservation Office (SHPO). THC provides technical assistance and oversees grants for preservation projects, maintains an inventory of the state's archaeological sites and historic places, and manages numerous federal and state conservation programs. The Commission sponsors multiple publications including an annual magazine and educational material for school curriculums. Additional information may be found here: http://www.thc.state.tx.us/about (Texas Historical Commission, 2016)

The Portal to Texas History

The Portal to Texas History is an online database developed and maintained by the University of North Texas. The database provides users with access to thousands of historical materials ranging from photographs to maps. Access to this resource is free to the public and can be found here: http://texashistory.unt.edu/ (University of North Texas, 2016).

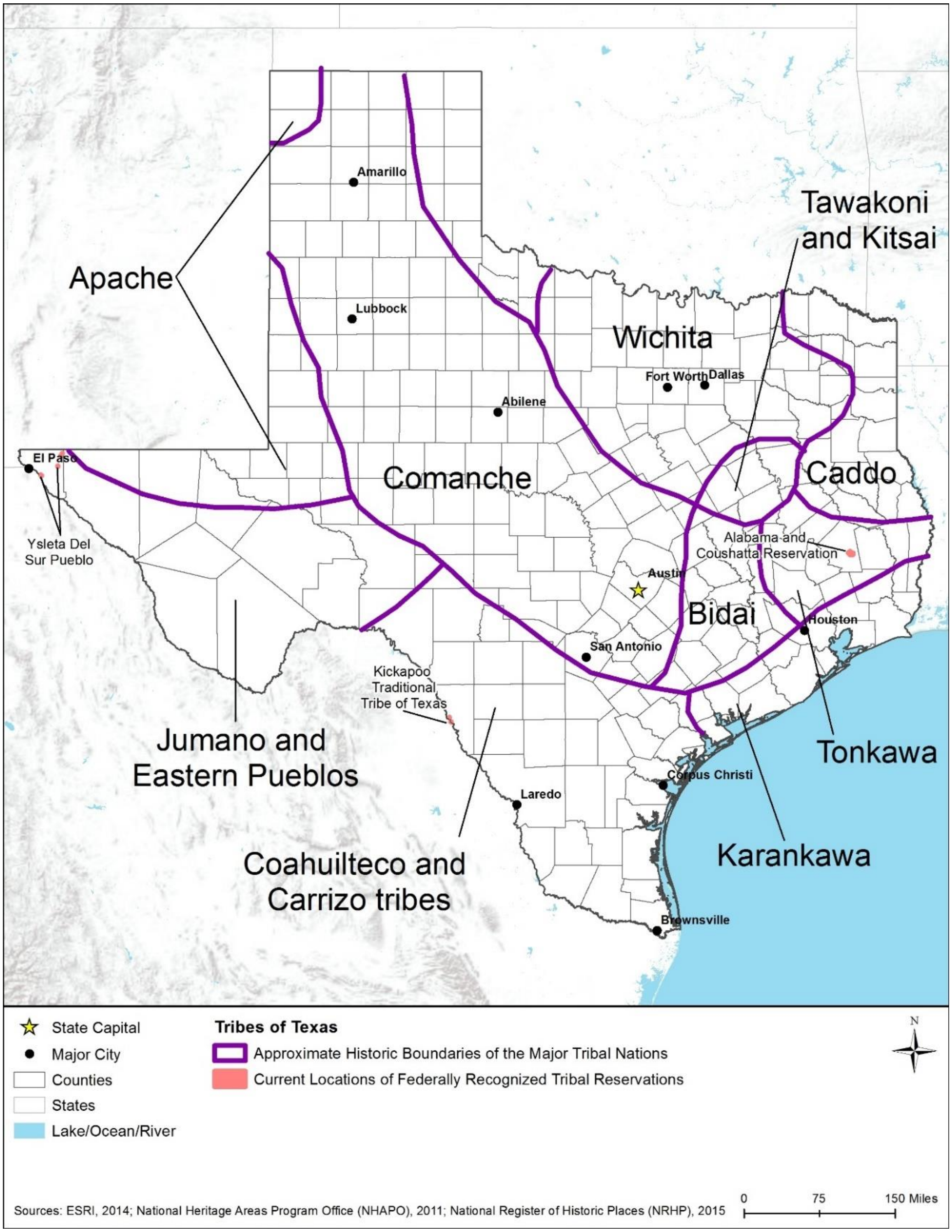


Figure 15.1.11-2: Federally Recognized Tribes in Texas[120]

[120] Figure 15.1.11-2 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.

Table 15.1.11-2: Archaeological Sites on the National Register of Historic Places in Texas

Closest City	Site Name	Type of Site
Adrian	Maston No. 13 Stone Wall (41OL249)	Historic
Adrian	Rocky Dell	Historic - Aboriginal, Prehistoric
Alba	Sadler Site	Prehistoric
Alice	Hinojosa Site	Prehistoric
Allamoore	Red Rock Archeological Complex	Prehistoric
Alto	Davis, George C., Site	Prehistoric
Alto	Davis, George C., Site (Boundary Increase)	Prehistoric
Amarillo	Proctor Pen I (41HT13)	Historic
Amarillo	Tafoya, Miguel, Place (41HT17)	Historic
Amarillo	Chavez City Ruins (41OL253)	Historic
Amarillo	Chavez Suburbs East and West (41OL254)	Historic
Amarillo	Green No. 5 (41OL257)	Historic
Amarillo	Griffin Site (41OL246)	Historic
Amarillo	Mansfield I (41OL50)	Historic
Amarillo	Maston I (41OL256)	Historic
Amarillo	Maston No. 52 (41OL235)	Historic
Amarillo	Stone Corrals No. 1-6 (41OL250)	Historic
Anderson	Piedmont Springs Archeological Site	Historic
Andrews	Andrews Lake Sites	Prehistoric
Arlington	Marrow Bone Spring Archeological Site	Historic, Prehistoric
Atascosa	Meyer Pottery Archeological Complex (41BX128)	Historic
Austin	Barton Springs Archeological and Historical District	Historic, Historic - Aboriginal, Prehistoric
Austin	Cox, Andrew M., Ranch Site	Historic, Prehistoric
Austin	Levi Rock Shelter	Prehistoric
Austin	Long Hog Hollow Archeological District	Prehistoric
Austin	Smith Rock Shelter	Prehistoric
Austin	Walnut Creek Archeological District	Prehistoric
Austin	Youth Council Site (41TV382)	Prehistoric
Baytown	Cedar Bayou Archeological District	Prehistoric
Blakeney	Kaufman, Sam, Site	Historic - Aboriginal, Prehistoric
Blum	Sheep Cave	Prehistoric
Breckenridge	Fort Davis Family Fort	Historic
Bronte	Fort Chadbourne	Historic, Military
Calliham	Pagan Site, (41LK58)	Prehistoric
Calliham	Mustang Branch Site	Prehistoric
Camp Verde	Old Camp Verde	Historic, Military
Camp Wood	Mission San Lorenzo de la Santa Cruz	Historic, Historic - Aboriginal
Canadian	Battle of Lyman's Wagon Train	Historic, Historic - Aboriginal, Prehistoric
Claude	Palo Duro Pen (41AM5)	Historic

Closest City	Site Name	Type of Site
Claude	Palo Duro Shelter (41AM6)	Historic
Comstock	Lower Pecos Canyon Archeological District	Prehistoric
Comstock	Seminole Canyon Archeological District	Historic, Historic - Aboriginal, Prehistoric
Comstock	Seminole Canyon District (Boundary Increase)	Historic, Historic - Aboriginal, Prehistoric
Comstock	Seven Mile Ranch Archeological District	Prehistoric
Comstock	West of Pecos Railroad Camps District	Historic
Corpus Christi	Oso Dune Site (41NU37)	Prehistoric
Corpus Christi	Tucker Site (41NU46)	Historic - Aboriginal, Prehistoric
Cove	Archeological Site (41-CH-110)	Historic - Aboriginal, Prehistoric
Cuero	Cuero I Archeological District	Historic - Aboriginal, Prehistoric
Dayton	Site (41Lb4)	Historic - Aboriginal
Del Rio	San Felipe Creek Archeological District	Prehistoric
Denton	Cranston Site	Historic
Denton	Lambert, J. C., Site	Historic
Denton	Roark-Griffith Site	Historic
Denton	Serren, A. H., Site	Historic
Denton	Wilson-Donaldson Site	Historic
Dinero	Fort Merrill	Historic, Military
Dryden	Bullis' Camp Site	Historic, Military
Dryden	Geddis Canyon Rock Art Site	Historic - Aboriginal
Dryden	Meyers Springs Pictograph Site	Historic, Historic - Aboriginal
Easton	Hudnall-Pirtle Site	Prehistoric
El Paso	Castner Range Archeological District	Prehistoric
El Paso	Doyle, Sgt., Site	Prehistoric
El Paso	Fusselman Canyon Rock Art District	Prehistoric
El Paso	Hot Well Archeological Site	Prehistoric
El Paso	Hueco Tanks	Historic - Aboriginal, Prehistoric
El Paso	Northgate Site	Prehistoric
Eldorado	Mittel Site	Prehistoric
Emory	Gilbert Site	Historic - Aboriginal, Prehistoric
Emory	Koons Site	Prehistoric
Emory	Yandell Site	Historic - Aboriginal, Prehistoric
Enchanted Rock	Enchanted Rock Archeological District	Prehistoric
Farmersville	Sister Grove Creek Site	Prehistoric
Faulkner	Mackin, A. C., Archeological Site	Prehistoric
Floresville	Rancho de las Cabras	Historic
Floydada	Floyd County Stone Corral	Historic
Floydada	Floydada Country Club Site	Historic - Aboriginal, Prehistoric
Fort Hancock	Alamo Canyon-Wilkey Ranch Discontiguous Archeological District	Prehistoric
Frankston	Saunders, A. C., Site	Prehistoric

Closest City	Site Name	Type of Site
Fredericksburg	Fort Martin Scott	Historic, Historic - Aboriginal, Prehistoric
Fritch	Antelope Creek Archeological District	Prehistoric
Fritch	McBride Canyon Ruin	Prehistoric
Fulton	Kent-Crane Shell Midden	Prehistoric
Galveston	SS SELMA (steamship)	Shipwreck
Galveston	USS HATTERAS (41GV68)	Shipwreck
Goliad	Nuestra Senora del Espiritu Santo de Zuniga Site	Historic, Prehistoric
Goliad	Ruins of Mission Nuestra Senora del Rosario de los Cujanes	Historic - Aboriginal
Hainesville	Haines, George W., Site	Historic
Hainesville	Moody, Joseph and Martha, Farmstead	Historic
Hainesville	Moody, Ned, Site	Prehistoric
Hillsboro	McKenzie Site	Prehistoric
Houston	Barker-Cypress Archeological Site (41HR436)	Prehistoric
Houston	Harris County Boy’s School Site	Prehistoric
Houston	Mansfield Street Archeological Site	Prehistoric
Huron	Bear Creek Shelter Site	Prehistoric
Inez	Fort St. Louis Site	Historic
Iraan	Camp Melvin Site	Historic, Military
Iraan	Harris Ranch Petroglyph Site (41CX110)	Prehistoric
Kennard	Westerman Mound	Prehistoric
Kingsbury	Dublin Plantation	Historic
Kiomatia	Kiomatia Mounds Archeological District	Historic, Prehistoric
Lake Whitney	Buzzard Cave	Prehistoric
Lake Whitney	Pictograph Cave	Historic - Aboriginal, Prehistoric
Lake Whitney Estates	Kyle Shelter	Prehistoric
Langtry	Mile Canyon	Prehistoric
Langtry	Rattlesnake Canyon Site	Prehistoric
Laredo	San Jose de Palafox Historic/Archeological District	Historic
Laredo	Dolores Nuevo	Historic
Liberty	Black Cloud	Historic
Linn	El Sal Del Rey Archeological District	Historic - Aboriginal, Prehistoric
Live Oak	Live Oak Park Site	Prehistoric
Lobo	Lobo Valley Petroglyph Site	Prehistoric
Lolita	Archeological Site (41JK9)	Historic
Lubbock	Canyon Lakes Archeological District	Prehistoric
Lubbock	Lubbock Lake Site	Historic - Aboriginal, Prehistoric
Manchester	Neely Site (41RR48)	Prehistoric
Marble Falls	Page, Louis, Archeological Site	Prehistoric
Marshall	Marshall Arsenal, CSA	Historic - Aboriginal, Military
Menard	Site of Presidio San Luis de las Amarillas	Historic, Military

Closest City	Site Name	Type of Site
Mobeetie	Battle of Sweetwater Creek	Historic, Historic - Aboriginal, Military
Montgomery	Kirbee Kiln Site	Historic
Mosheim	Hog Creek Archeological District	Historic, Prehistoric
Natural Bridge Caverns	Natural Bridge Caverns Sinkhole Site	Prehistoric
Noodle	Steadman, Foy, Site	Prehistoric
Ozona	Turkey Roost Petroglyph Site	Prehistoric
Paint Rock	Paint Rock Indian Pictograph Site	Prehistoric
Palestine	Pace McDonald Site	Historic - Aboriginal, Prehistoric
Panther Junction	Burro Mesa Archeological District	Historic, Historic - Aboriginal, Prehistoric
Perryton	Buried City Site (41OC1)	Prehistoric
Pin Hook	Ellis II Site	Prehistoric
Pin Hook	Emerson Site	Prehistoric
Pin Hook	Loma Alto Site	Prehistoric
Pin Hook	Swindle Site	Prehistoric
Pin Hook	McCarty Site	Prehistoric
Plainview	Plainview Site	Prehistoric
Port Isabel	Brazos Santiago Depot (41CF4)	Historic, Military
Port Isabel	Garcia Pasture Site	Prehistoric
Port Isabel	Mansfield Cut Underwater Archeological District	Historic, Military
Post	Cooper's Canyon Site (41GR25)	Historic, Prehistoric
Post	O.S. Ranch Petroglyphs (41GR57)	Prehistoric
Post	Post West Dugout	Historic
Post	Post-Montgomery Site (41GR188)	Prehistoric
Presidio	La Junta de los Rios Archeological District	Historic, Historic - Aboriginal, Prehistoric
Quitaque	Lake Theo Folsom Site Complex	Prehistoric
Quitman	Howle Site	Prehistoric
Quitman	Osborn Site	Historic - Aboriginal, Prehistoric
Redford	Tapalcomes	Historic - Aboriginal, Prehistoric
Rio Vista	Ham Creek Site	Prehistoric
Rockdale	San Xavier Mission Complex Archeological District	Historic - Aboriginal, Prehistoric
Round Rock	Kenney's Fort Site (41WM465)	Historic
Salado	Salado College Archeological Site	Historic
Salt Flat	McKittrick Canyon Archeological District, Guadalupe Mountains National Park	Historic - Aboriginal, Prehistoric
Salt Gap	Bishop Site	Prehistoric
San Antonio	Maverick-Altgelt Ranch and Fenstermaker-Fromme Farm	Historic, Prehistoric
San Antonio	Presnall-Watson Homestead	Historic
San Antonio	Salado Battlefield and Archeological Site	Historic, Prehistoric, Military
San Antonio	Source of the River District	Historic, Prehistoric

Closest City	Site Name	Type of Site
San Antonio	Voelcker Farmstead Historic District	Historic, Prehistoric
San Antonio	Walker Ranch	Historic, Prehistoric
San Augustine	Mission Nuestra Senora de los Dolores de los Ais Site	Historic, Historic - Aboriginal
San Marcos	Freeman, Harry, Site	Historic - Aboriginal
San Marcos	Norman, Ruskin C., Site (41 HY 86)	Prehistoric
San Ygnacio	Dolores Viejo	Historic
Seabrook	Armand Bayou Archeological District	Historic, Prehistoric
Seguin	Wilson Utility Pottery Kilns Archeological District	Historic
Sheffield	Live Oak Creek Archeological District	Historic, Historic - Aboriginal, Prehistoric, Military
Sheffield	Canon Ranch Archeological District	Historic, Prehistoric
Sheffield	Wroe Ranch Shelter No. 1	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ1)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ181)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ182)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ183)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ184)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ190)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ200)	Historic, Prehistoric
Sierra Blanca	Archeological Site No. (41HZ220)	Historic
Sierra Blanca	Archeological Site No. (41HZ227)	Historic
Sierra Blanca	Archeological Site No. (41HZ228)	Historic
Sierra Blanca	Archeological Site No. (41HZ283)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ284)	Historic
Sierra Blanca	Archeological Site No. (41HZ285)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ286)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ287)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ288)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ289)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ290)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ291)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ292)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ293)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ294)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ295)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ296)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ297)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ298)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ299)	Historic
Sierra Blanca	Archeological Site No. (41HZ300)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ301)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ302)	Prehistoric

Closest City	Site Name	Type of Site
Sierra Blanca	Archeological Site No. (41HZ303)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ304—305)	Historic, Prehistoric
Sierra Blanca	Archeological Site No. (41HZ306)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ307)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ308)	Historic
Sierra Blanca	Archeological Site No. (41HZ309)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ311)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ312)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ313)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ339)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ340)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ409)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ410)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ411)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ412)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ413)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ414)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ415)	Historic
Sierra Blanca	Archeological Site No. (41HZ416)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ417)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ418)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ419)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ420)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ421)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ422)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ423)	Historic, Prehistoric
Sierra Blanca	Archeological Site No. (41HZ424)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ425)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ426)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ427)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ428)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ429)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ430)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ431)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ432)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ433)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ434)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ435)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ436)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ437)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ438)	Historic
Sierra Blanca	Archeological Site No. (41HZ439)	Historic, Military

Closest City	Site Name	Type of Site
Sierra Blanca	Archeological Site No. (41HZ440)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ441)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ442)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ443)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ445)	Historic
Sierra Blanca	Archeological Site No. (41HZ448)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ464)	Prehistoric
Sierra Blanca	Archeological Site No. (41HZ465)	Historic
Sierra Blanca	Archeological Site No. (41HZ7)	Prehistoric
Sierra Blanca	Indian Hot Springs Health Resort Historic District	Historic
Sierra Blanca	Tinaja de las Palmas Battle Site	Historic
Sierra Blanca	Johnson, Rod, Site	Historic
Socorro	Mission Socorro Archeological Site	Historic - Aboriginal
South Bend	Harrell Site	Prehistoric
Spanish Fort	Spanish Fort Site	Historic - Aboriginal, Prehistoric
Spicewood	Krause Spring Site	Prehistoric
Stinnett	Adobe Walls	Historic, Historic - Aboriginal, Military
Surfside	GEN. C. B. COMSTOCK (dredge) Shipwreck Site	Shipwreck
Tatum	Harmony Hill Site	Historic
Tatum	Musgano Site	Prehistoric
Tehuacana	Vinson Site	Historic - Aboriginal
Texarkana	Roseborough Lake Site	Historic - Aboriginal, Prehistoric
Texarkana	Texarkana Phase Archeological District	Historic, Prehistoric
Texarkana	Tilson Mounds--Summerhill Lake Place (41BW14)	Prehistoric
Toyah	Granado Cave	Prehistoric
Toyahvale	Phantom Lake Spring Site	Historic, Prehistoric
Uvalde	Fort Inge Archeological Site	Historic, Prehistoric
Uvalde	Leona River Archeological Site	Prehistoric
Uvalde	Taylor Slough Archeological Site	Prehistoric
Uvalde	Uvalde Flint Quarry	Prehistoric
Uvalde	Willingham Site	Prehistoric
Vega	Landergin Mesa	Prehistoric
Victoria	Mission Creek Dam and Acequia Site	Historic - Aboriginal
Victoria	Tonkawa Bank Site	Historic - Aboriginal, Prehistoric
Victoria	Willeke Site	Prehistoric
Waco	Torrey's Trading House No. 2 Site	Historic - Aboriginal
Wallis	Allens Creek Ossuary Site	Prehistoric
Wallisville	Old Wallisville Town Site	Historic
Wallisville	El Orcoquisac Archeological District	Historic - Aboriginal, Prehistoric
Winfield	Hale Mound Site	Prehistoric

Source: (NPS, 2015o)

15.1.11.7. Historic Context

While the coast of Texas was mapped by Spanish explorer and cartographer Alonso Alvarez de Pineda in 1519, exploration did not commence until a decade later, when the ship of Alvar Núñez Cabeza de Vaca wrecked in 1528 near present-day Galveston. Spanish explorers, such as Francisco Vazquez de Coronado's expedition in 1541, continued to trek through Texas during the 16th and 17th centuries, with explorers crossing through Texas in search of gold. Colonization efforts continued during the 16th and 17th centuries, with the establishment of missions, presidios, and small settlements. The French also laid claim to Texas, when in 1685, French explorer Rene-Robert Cavelier, Sieur de La Salle established a short-lived and ill-fated settlement on the Gulf of Mexico in southeast Texas. In 1718, the Alamo was built, serving as the chapel for the larger San Antonio de Valero mission, and marking the founding of San Antonio. Texas remained a part of Spanish Mexico until 1821, when Mexico revolted and finally gained its independence from Spain (Texas State Historical Association, 2015b).

In addition to those of Spanish heritage, early settlers in Texas included immigrants from Ireland, the Canary Islands, Germany, and domestic immigrants from eastern states. During the first half of the 19th century, the residents of the future state of Texas were involved in multiple conflicts with the Mexican government regarding their desire to be independent from Mexico. On March 2, 1836, the Texas Declaration of Independence was adopted, several days after the beginning of the siege of the Alamo, which began on February 23, 1836; the Battle of the Alamo ended on March 6, 1836, when its defenders were all killed by overwhelming Mexican forces led by President General Antonio Lopez de Santa Anna.

In 1837, the Republic of Texas was recognized by the United States, France, England, Belgium, and the Netherlands (Texas State Historical Association, 2015c). On December 29, 1845, Texas was admitted to the Union as the 28th state, ultimately sparking the 2-year Mexican-American War (1846 to 1848). The Mexican-American War ended in 1848 with the signing of the Treaty of Guadalupe Hidalgo, resulting in Mexico's cession of much of the present-day southwestern United States (Texas State Historical Association, 2015d).

Texas' first railroad began operating in 1850. American Indian reservations were established in Texas as well; however, many were eventually moved to Oklahoma as the population increased and land became more valuable. Texas voted to secede during the Civil War; however, not all in power were in favor, one of which was Sam Houston, who chose to resign as governor in protest. During the war, battles occurred at Galveston, Corpus Christ, and Brownsville (Texas State Historical Association, 2015e). Following the Civil War, large-scale cattle drives occurred in Texas, moving herds to larger Midwestern markets; cattle drives eventually became unnecessary in favor of rail transportation. On October 4, 1876, "the Agricultural and Mechanical College, later Texas A&M University, open(ed) at College Station, becoming the first public institution of higher learning in the state," and in 1883, classes began at the University of Texas (Texas State Historical Association, 2015f).

Oil was discovered in Texas in 1894, marking an important event in the development of the state into a major oil producer (Texas State Historical Association, 2015f). In 1900, Galveston experienced the most destructive natural disasters in recorded North American history as a hurricane killed as many as 6,000 people. Oil exploration continued to expand during the early 20th century, resulting in the further growth of the industry in Texas. Texas was affected by raids of its border towns during the Mexican Civil War (1911 to 1920), as well as by the general war effort during World War I (WWI) and World War II (WWII) through mobilization of the state's citizens for either service abroad or for domestic production of wartime goods (Texas State Historical Association, 2015g).

Texas has 3,206 National Register of Historic Places (NRHP) listed sites, as well as 46 National Historic Landmarks (NHL) (NPS, 2015g). Texas does not contain a National Heritage Area (NHA) (NPS, 2015p). Figure 15.1.11-3 shows the location of NRHP sites within the state of Texas.

15.1.11.8. Architectural Context

Despite earlier exploration, European architecture did not appear in Texas until the late 17th century, consisting primarily of wooden fortifications meant to provide protection for colonists. The French explorer Rene-Robert Cavelier, Sieur de La Salle was one of the first to attempt a permanent settlement in 1685 near what is now Victoria, Texas. Spain chose to redouble their settlement efforts afterwards and began establishing missions throughout the southern half of present day Texas, sited largely along important river routes and the El Camino Real, a major roadway connecting Mexico City and Santa Fe, New Mexico. Portions of El Camino Real remain today and are still visible on the landscape. Agricultural centers were also established in fertile areas. Early settlements consisted largely of log structures, with later structures, such as San Antonio de Valero, being built of stone by masons from Mexico (Steely, et al., 2013).

During the 18th century, "typical North African and Iberian building practices used mud, adobe, stone (where available), and scrub wood to construct residential, storage, civic, and religious buildings close to each street with protected patios and courts inside" (Steely, et al., 2013). Adobe was particularly common in west Texas where lumber was less available and indigenous buildings traditions were adopted due to their practicality with respect to the environment (Newlan, 2008).

Following Mexican independence in 1812, American settlers began to move into the area in greater numbers, bringing with them the tradition of the log cabin, dogtrot, and house with the shed-roofed porch (possibly from the Caribbean). This build type was used not only for residential structures, but also for courthouses, schools, and churches. Galveston was established in 1816 but did not begin to develop greatly until 1836 when French-Canadian merchant Michel Branamour Menard and several associates purchased and began platting more than 4,600 acres that would form a large part of the city. Settlers and new immigrants to the city built a variety of structures, including a number of wooden Greek Revival structures, with their milled elements being imported from the New England. Gothic Revival structures, churches in particular, were built starting in the middle of the 19th century. (Steely, et al., 2013)

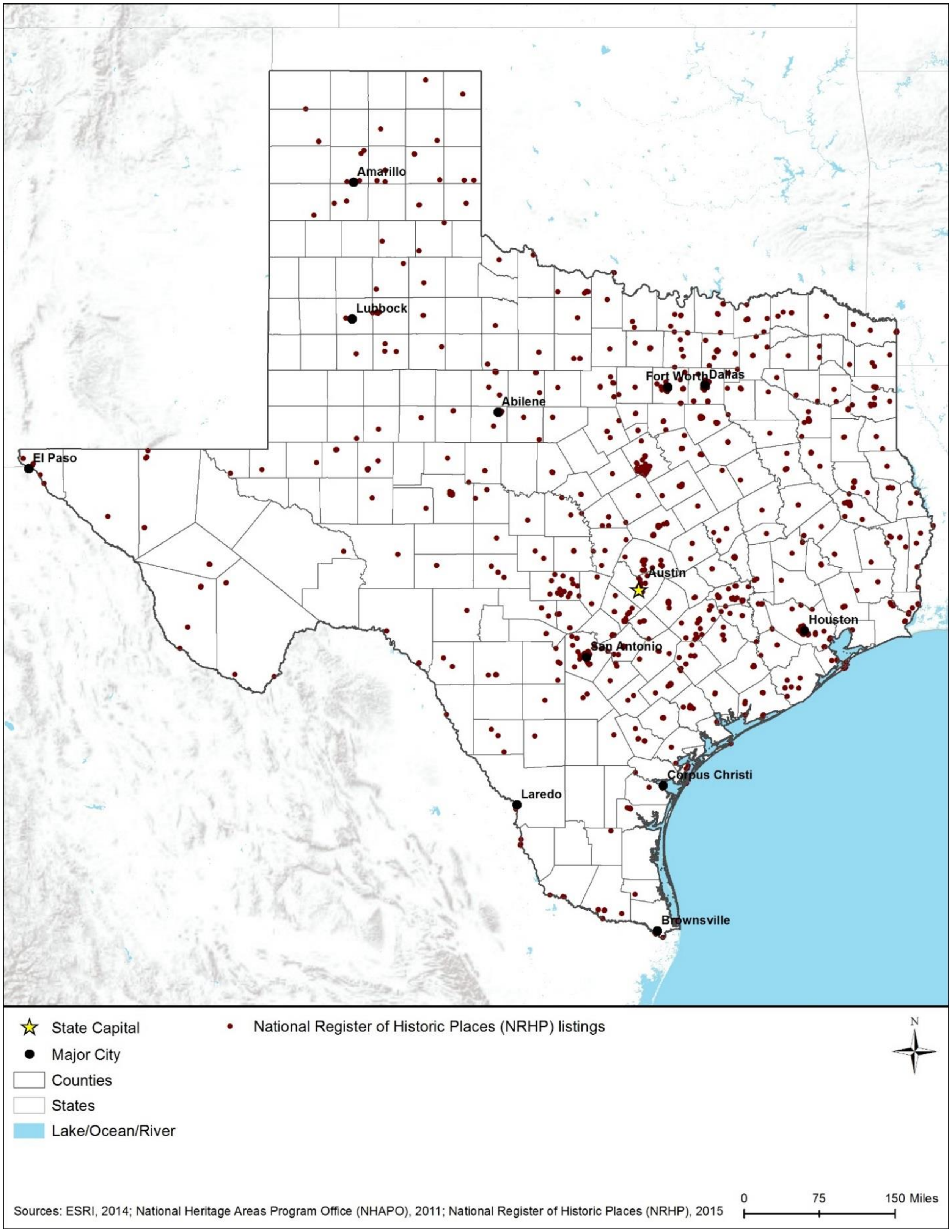


Figure 15.1.11-3: National Heritage Areas (NHA) and National Register of Historic Places (NRHP) Sites in Texas

After Texas joined the United States in 1846, the state began to expand its public infrastructure, constructing public buildings, many of which were built in the Greek Revival style. The Rundbogenstil style, a German revival style drawing on Romanesque elements, was built as Germans immigrated to Texas and exerted their influence on the state's architecture. Educational and health institutions were built during this time as well, such as the State Lunatic Asylum (1857), in Austin. Early town planning that was dominated by Spanish urban planning traditions, was rectangular in nature, and featured open spaces in the center of town; however, as town planning evolved following the arrival of the railroad it became more linear, with important real estate being oriented along the rail line. During the second half of the 19th century, buildings were built in Italianate and Romanesque styles, using balloon-framing techniques. Classicism returned starting in the late 1890s, with additional revival styles becoming popular as well. Art Deco and Art Moderne were popular during the Great Depression, taking advantage of New Deal construction money and work relief programs. (Steely, et al., 2013)

Texas experienced a wave of construction during and after WWII, with military facilities being constructed during the war, including training camps, airfields, and additional base facilities, while after the war large-scale housing tracts were built to house returning veterans. A great migration of Texans from rural to urban areas occurred during this time, as industry within the state increased. The petroleum industry is an example that continued to grow during the 20th century. (Steely, et al., 2013)

Additional building types include lumbering milling facilities dating to the early 20th century, primarily in east Texas, many of which went out of business after the collapse of the industry during the 1920s (NRHP, 2001). Texas also has a variety of educational facilities, including African American schools built through the Rosenwald school program during the early 20th century (NRHP, 1998).

Top Left – Doorway to the Alamo (San Antonio, TX) – (Highsmith, Doorway to the Alamo, an 18th-century mission church in San Antonio, Texas, 2014a)
Top Right – Texas State Capitol (Austin, TX) – (Highsmith, The Texas Capitol, Austin, Texas, 2014b)
Bottom Left – Gruene, Family Home (New Braunfels, TX) – (Highsmith, The 1872 Gruene Family Home, a Victorian-style house in the German-immigrant cotton-farming community of Gruene, now part of New Braunfels, Texas, 2014c)
Bottom Middle – Kilgore Oil Wells (Kilgore, TX) – (Vachon, 1943)
Bottom Right – Anthony D. Kennard House (Roans Prairie, TX) – (Historic American Buildings Survey, 1933)

Figure 15.1.11-4: Representative Architectural Styles of Texas

15.1.12. Air Quality

15.1.12.1. 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[121] 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)[122] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[123] This section discusses the existing air quality in Texas. The USEPA designates areas within the United States as attainment,[124]

[121] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[122] Equivalent to 1 milligram per liter (mg/L).
[123] 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, 2015p).
[124] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015q).

nonattainment,[125] maintenance,[126] or unclassifiable[127] 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.

15.1.12.2. Specific Regulatory Considerations

The following is a discussion of the various components that comprise Texas's air quality compliance requirements.

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 (Pb), nitrogen dioxide (NO_2), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and sulfur dioxide (SO_2). There are both primary[128] and secondary[129] NAAQS for each pollutant with varying averaging times; primary standards are established to protect public health, while secondary standards are intended to protect against harm to public welfare through such effects as decreased visibility, and harm to animals, crops, vegetation, buildings, etc. (USEPA, 2017) 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, 2013d) A description of the NAAQS is presented in Appendix C, Environmental Laws and Regulations. The Texas Air Control Board, a predecessor agency of TCEQ, adopted a rule stating that the NAAQS would be enforced in Texas. TCEQ has since developed and adopted selected state standards for various pollutants[130] (Office of the Secretary of State, 2015).

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, including increased risk of cancer, reproductive issues, or birth defects. HAPs are federally regulated under the CAA via the National Emission Standards for Hazardous Air Pollutants (NESHAPs). USEPA developed the NESHAPs for sources and source categories emitting HAPs that pose a risk to human health. (USEPA, 2016b) Appendix C, Environmental Laws and

[125] 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, 2015q).
[126] 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, 2015q).
[127] 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, 2015q).
[128] 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, 2014e).
[129] 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, 2014e).
[130] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.

Regulations, presents a list of federally regulated HAPs. The TCEQ reviews the emissions of HAPs by state toxicity standards referred to as either effects screening levels (ESLs) or air monitoring comparison values (AMCVs)[131]. (TCEQ, 2014b) ESLs are used to evaluate emissions during the permitting process, establishing an allowable concentration for a given pollutant. Exceedences of those allowable concentrations trigger more in-depth analysis. AMCVs are used to evaluate ambient concentrations of pollutants recorded by either fixed or mobile monitoring equipment. As with ESLs, exceedance of an allowable concentration of a monitored pollutant triggers further study that may lead to an enforcement action[132] (TCEQ, 2017c).

Title V Operating Permits/State Operating Permits

Texas has delegated authority 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). 30 TAC§ 122 (Federal Operating Permits Program) describes the applicability of Title V operating permits (Office of the Secretary of State, 2015). Texas 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 (Table 15.1.12-1). Texas also requires a Title V permit for sources including those subject to regulation to the EPA’s Acid Rain Program, as well as non-major sources designated by TCEQ[133]. (TCEQ, 2017d) (TCEQ, 2014c)The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 15.1.12-1: Major Air Pollutant Source Thresholds

Pollutant	TPY
Any Criteria Pollutanta	100 Tons per Year
Single HAP	10 Tons per Year
Total/Cumulative HAPs	25 Tons per Year

Source: (USEPA, 2014b)

Sources in nonattainment areas will have lower thresholds for some criteria pollutants depending on the classification of the nonattainment area. In addition to Title V operating permits, the TCEQ issues general operating permits under 30 TAC§ 122.501 (General Operating Permits) for minor, stationary sources subject to the Title V program[134]. (TCEQ, 2017d) General operating

[131] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.
[132] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.
[133] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.
[134] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.

permits are intended to provide a streamlined application and permitting process for sites that have similar characteristics, such as operations, emissions, and applicable requirements[135]. Some are subject to case-by-case review, although some qualify for permits by rule, discussed below, or standard permits, which also do not require case-by-case review. TCEQ conducts New Source Reviews (NSRs), which are preconstruction air quality permits. They are required under 30 TAC§ 116.110 for any new facility, or modification of an existing facility, that emits air pollutants. (TCEQ, 2017e) TCEQ also issues permits by rule under 30 TAC§ .106 (Permits By Rule) for minor sources that will not emit a significant amount of pollutants into the atmosphere if regulated under this permit. TCEQ may issue a permit by rule for facilities that do not exceed the following limits:

- 250 tpy of CO or NO_x;
- 25 tpy of VOCs, SO_2 , or inhalable PM;
- 15 tpy of PM_{10};
- 10 tpy of $PM_{2.5}$ (Office of the Secretary of State, 2015); or
- 25 tpy of any other air contaminant except:
  - water, nitrogen, ethane, hydrogen, and oxygen; and
  - notwithstanding any provision in any specific permit by rule to the contrary, greenhouse gases as defined in §101.1. (Office of the Secretary of State, 2015)

Exempt Activities

TCEQ does not explicitly exempt any source from obtaining a permit; however, stationary sources that are not a major source (see Table 15.1.12-2) are not required to obtain a Title V operating permit because Title V does not apply. All activities should review applicable stationary source requirements, or contact TCEQ for additional assistance. (Office of the Secretary of State, 2015)

Temporary Emissions Sources Permits

Texas can issue Title V temporary operating permits for major sources located at a site for less than six months that do not affect the determination of major source requirement for other stationary sources located at other sites. 30 TAC§ 122.204 (Temporary Sources) "a single permit may be issued authorizing similar operations by the same temporary source at multiple temporary locations." (Office of the Secretary of State, 2015)

New Source Review Preconstruction Permits

30 TAC§ 116.110 (Applicability) requires any person planning to construct a new facility that has the potential to emit air contaminants to obtain a New Source Review permit, under 30 TAC§ 116.111 (General Application). Some New Source Review Permits are evaluated case-by-case by TCEQ due to the varying nature of the facilities, as discussed above under Title V Permits. Before any work may begin on either construction of a new facility or modification of a

[135] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.

facility that produces air emissions, the proponent must either obtain a permit under §116.111; satisfy the conditions for a standard permit; satisfy the conditions for a flexible permit; satisfy the conditions for a permit by rule; or satisfy the criteria for a de minimis facility or source[136]. Where required, registrations for standard permits are reviewed for compliance with the terms and conditions of the standard permit (Office of the Secretary of State, 2015).

General Conformity

Established under Section 176(c)(4) of the CAA, "the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality" outlined in the state implementation plan (SIP) (USEPA, 2013a). 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 (USGPO, 2010). However, the construction of a communications system to support emergency response activities would not be considered an emergency response activity, and therefore may be subject to conformity requirements in nonattainment and maintenance areas.

The estimated pollutant emissions are compared to *de minimis*[137] levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 15.1.12-2. As a result, lower *de minimis* thresholds for VOCs and NO_X could apply depending on the attainment status of a county.

If an action does not result in an estimated emissions increase at or above the *de minimis* levels in Table 15.1.12-2, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are at or above the *de minimis* levels in Table 15.1.12-2, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. (USEPA, 2010b). To demonstrate conformity,[138] 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;

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[136] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.
[137] *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, 2016e).
[138] Conformity: Compliance with the State Implementation Plan.

- 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, 2010b).

Table 15.1.12-2: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_X)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an Ozone Transport Region (OTR)	100
Ozone (NO_X)	Maintenance inside an OTR	100
Ozone (VOC)	Maintenance outside an OTR	100
Ozone (VOC)	Maintenance inside an OTR	50
CO, SO_2, NO_2	All Nonattainment and Maintenance	100
PM_{10}	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
$PM_{2.5}$ (Direct Emissions) (SO_2) (NO_X (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (USGPO, 2010)

State Implementation Plan Requirements

The Texas SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Texas' SIP is a conglomeration of separate actions taken for each of the pollutants, and contains additional stipulations relating to legal authority, enforcement, and other administrative provisions[139]. (TCEQ, 2016a) All of Texas' SIP actions are codified under 40 CFR Part 52 Subpart SS. A list of all SIP actions for all six criteria pollutants can be found on TCEQ's website.

15.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, or unclassifiable for six criteria pollutants; if a nonattainment area is brought into attainment, it is then classified as a maintenance area. 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, 2017) Figure 15.1.1-12

[139] TCEQ comments received 12/21/2016. See Appendix F, Draft PEIS Public Comments, for the full text of the TCEQ Comments.

and Table 15.1.12-3, below, present the nonattainment areas in Texas as of January 30, 2015. Table 15.1.12-3 contains a list of the counties and their respective current nonattainment status for each criteria pollutant. The year(s) listed in the table for each pollutant indicate when USEPA promulgated the standards for that pollutant; note that, for $PM_{2.5}$, O_3, and SO_2, these standards listed are in effect simultaneously. Unlike Table 15.1.12-3, Figure 15.1.1-12 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

Table 15.1.12-3: Texas Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1979	2008	1971	1987	1997	2006	1997	2008	1971	2010
Brazoria								X-2	X-5		
Chambers								X-2	X-5		
Collin		M	X-6					X-3	X-4		
Dallas								X-3	X-4		
Denton								X-3	X-4		
El Paso	M				X-4						
Ellis								X-3	X-4		
Fort Bend								X-2	X-5		
Galveston								X-2	X-5		
Hardin								M			
Harris								X-2	X-5		
Jefferson								M			
Johnson								X-3	X-4		
Kaufman								X-3	X-4		
Liberty								X-2	X-5		
Montgomery								X-2	X-5		
Orange								M			
Parker								X-3	X-4		
Rockwall								X-3	X-4		
Tarrant								X-3	X-4		
Victoria											
Waller								X-2	X-5		
Wise									X-4		

Source: (USEPA, 2015i)

X-1 = Nonattainment Area (Extreme)
X-2 = Nonattainment Area (Severe)
X-3 = Nonattainment Area (Serious)
X-4 = Nonattainment Area (Moderate)
X-5 = Nonattainment Area (Marginal)
X-6 = Nonattainment Area (Unclassified)
M = Maintenance Area

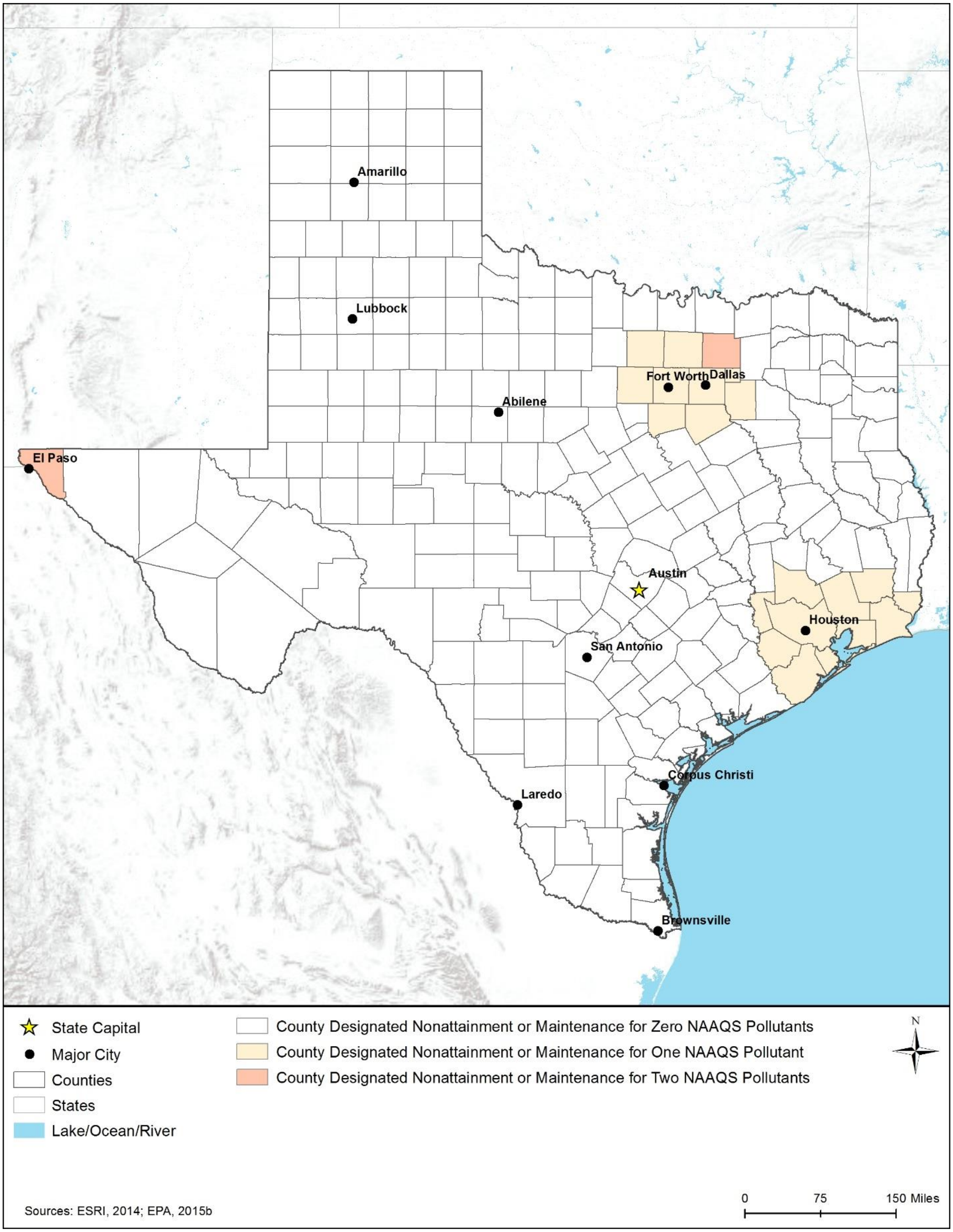


Figure 15.1.12-1: Nonattainment and Maintenance Counties in Texas

Air Quality Monitoring and Reporting

TCEQ measures regulatory compliance for criteria air pollutants at over 100 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (TCEQ, 2015n). In compliance with its obligations under 40 CFR Part 58.10, Texas develops an Annual Monitoring Network Plan that provides the "implementation and maintenance framework for an air quality surveillance system, known commonly as the ambient air quality monitoring network" (TCEQ, 2017f). TCEQ reports real-time pollution levels of NO_2, O_3, SO_2, PM_{10}, $PM_{2.5}$, and CO on their website.

Throughout 2014, O_3 measurements exceeded the federal standard of 0.075 ppm at 35 locations in Texas with the following maximum values listed in Table 15.1.12-4. Note that compliance with the federal 8-hour O_3 measurements is based on a 3-year average of the fourth highest measurement, not maximum exceedances. The table below reflects levels recorded on 8-hour O_3 high value days for 2014 in communities where TCEQ measures O_3, although not all of the locations listed supply data used for regulatory compliance purposes.

Table 15.1.12-4: Texas 2014 Max Exceedances

Region	Location	Max Exceedances (ppm)
Houston-Galveston-Brazoria	Manvel Croix Park	95
	Houston. Deer Park	86
	UH WG Jones Forest	83
	Mustang Bayou	82
	Katy Park	81
	UH West Liberty	80
	Conroe Relocated	80
	Danciger	78
	Wallisville Road	78
	Galveston 99th St.	76
	Houston Croquet	76
	Houston Monroe	76
	Houston Westhollow	76
	UH Moody Tower	76
San Antonio	Heritage Middle School	91
	Calaveras Lake	81
	San Antonio Northwest	79
	City of Garden Ridge	77
	Camp Bullis	76
	CPS Pecan Valley	76

Region	Location	Max Exceedances (ppm)
Dallas-Fort Worth	Granbury	91
	Pilot Point	88
	Ft. Worth Northwest	88
	Frisco	83
	Denton Airport South	83
	Grapevine Fairway	82
	Keller	80
	Cleburne Airport	79
	Parker County	78
	Eagle Mountain Lake	78
	Arlington Municipal Airport	78
Beaumont-Port Arthur	SETRPC 40 Sabine Pass	80
	SETRPC Mauriceville 42	79
Corpus Christi-Victoria	Holly Road	76
	Cuero	76

Source: (TCEQ, 2017g)

Air Quality Control Regions

USEPA classified all land in the U.S. 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[140] of a Class I area. "The [US]EPA's policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers" (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

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

- 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 100 kilometers[141] (the normal useful range of [US]EPA-approved Gaussian plume models" (USEPA 1992).

Texas contains two Class I areas: Guadalupe Mountains National Park and Big Bend National Park. New Mexico has one Class I area, Carlsbad Caverns National Park, where the 100-km buffer intersects Texas counties. Oklahoma has one Class I area, Wichita Mountains Wilderness Area, comprised of two parts (North Mountain Unit and Charons Garden Unit) where the 100-km buffer intersects Texas counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. (USEPA, 2016g) provides a map of Texas highlighting all relevant Class I areas and all areas within the 100-km radiuses. The numbers next to each of the highlighted Class I areas in Figure 15.1.12-2 correspond to the numbers and Class I areas in Table 15.1.12-5.

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

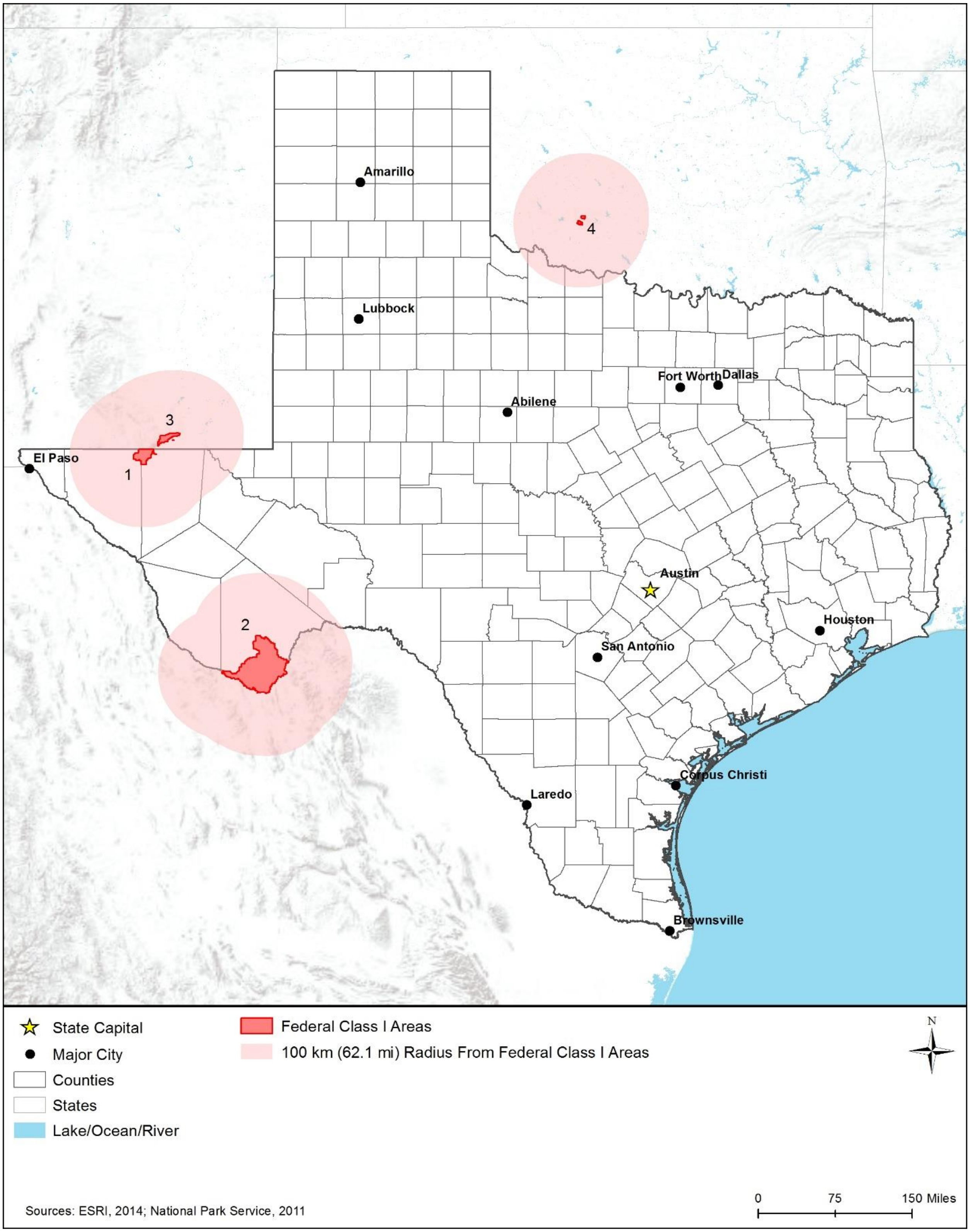


Figure 15.1.12-2: Federal Class I Areas with Implications for Texas

Table 15.1.12-5: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Guadalupe Mountains National Park	76,292	TX
2	Big Bend National Park	708,118	TX
3	Carlsbad Caverns National Park	46,435	NM
4	Wichita Mountains Wilderness Area	8,900	OK

Source: (USEPA, 2016g)

[a] The numbers correspond to the shaded regions in Figure 15.1.12-2.

15.1.13. Noise and Vibration

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

15.1.13.1. Definition of the Resource

Noise is a form of sound caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012c). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

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.

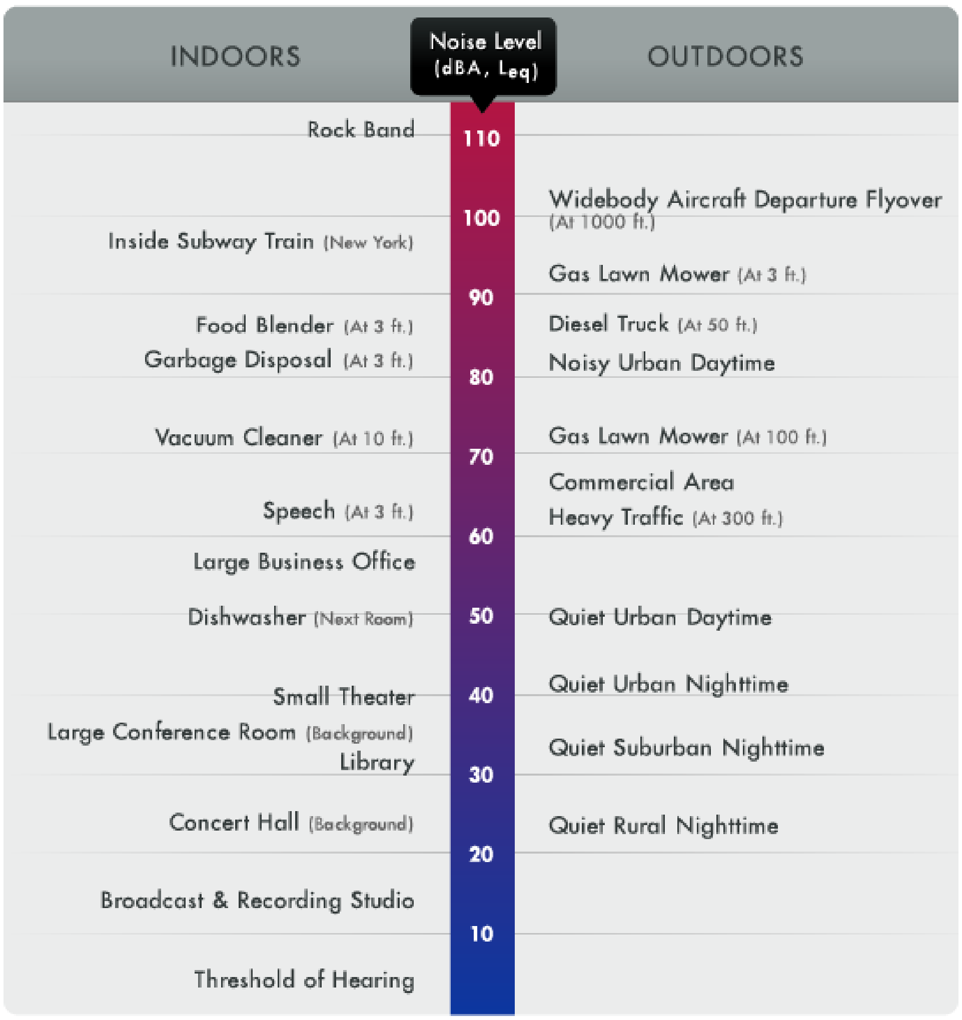
Fundamentals of Noise

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”). 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.

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.
- The changes in frequency characteristics or pressure levels through time.

Figure 15.1.13-1 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 15.1.13-1: Sound Levels of Typical Sounds

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, 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 causing 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 if the environment is urban, suburban, or rural.

Related to noise, vibration is a fluctuating motion described by displacement with respect to a reference point. Depending on the intensity, vibrations ma y create perceptible ground shaking and the displacement of nearby objects as well as rumbling sounds. Table 15.1.13-1 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 15.1.13-1: Vibration Source Levels for Select Construction Equipment (VdB)

Equipment[a]	VdB[b] 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

[a] The types of equipment listed in this table are included for reference purposes only. It is possible that not all equipment types listed here would be used in the deployment and operation of the Proposed Action.
[b] VdB = vibration decibels

15.1.13.2. 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.

Texas does not have any state-wide noise regulations that would apply to 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 Dallas, Houston, Austin, and San Antonio, 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).

15.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Texas varies widely based on the area and environment of the area. The population of Texas can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 15.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Texas may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Texas. As such, this section describes the areas where the population of Texas 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) (USDOI, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Dallas, Houston, Austin, and San Antonio, along with their neighboring boroughs and cities.
- **Airports:** Areas surrounding airports tend to be more sensitive to noise due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but, based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports are in the proximity of urban communities; therefore, aircraft operations (arrivals/departures) can result in noise exposure in the surrounding areas to be at higher levels with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Texas, Dallas/Fort Worth International Airport (DFW), George Bush Intercontinental Airport (IAH), William P. Hobby Airport (HOU), Austin-Bergstrom International Airport (AUS), San Antonio International Airport (SAT), Dallas Love Field (DAL) and El Paso International Airport (ELP) have more than 3.7 million annual operations combined (FAA, 2015i). These operations result in increased ambient

noise levels in the surrounding communities. See Section 15.1.7, Land Use, Recreation, and Airspace, and Figure 15.1.7-5 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, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living in those areas. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 15.1.1, Public Safety Infrastructure, and Figure 15.1.1-1 for more information about the major highways in the state.
- **Railways**: Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (USDOT, 2015b). Texas has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from major cities in Texas, such as Dallas or Houston to other cities in Texas, Oklahoma, Louisiana, and New Mexico, such as the Union Pacific and BNSF Railway. There are also a number of other rail corridors that join these major rail lines and connect with other cities (TxDOT, 2015f). See Section 15.1.1, Public Safety Infrastructure, and Figure 15.1.1-1 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, 2014e). Texas has 14 national park units and 20 National Natural Landmarks (NPCA, 2015) (NPS, 2015e). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 15.1.7, Land Use, Recreation, and Airspace, and Figure 15.1.7-3 for more information about national and state parks in Texas.

15.1.13.4. Sensitive Noise and Vibration Receptors

Noise- and vibration-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise receptors are typically areas where the intrusion of noise and vibration can disrupt the use of the environment. A quiet urban area usually has a typical noise level in the daytime of 50 dBA, and 40 dBA during the evening. Noise levels in remote wilderness and rural nighttime areas are usually 30 dBA (BLM, 2014). Most cities and towns in Texas 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 throughout the state of Texas.

15.1.14. Climate Change

15.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity" (IPCC, 2007).

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gases (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012d). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e)[142], which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" (IPCC, 2007). "Atmospheric concentrations of CO_2 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_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Section 15.2, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation; 3) sea level; and 4) severe weather events (including tropical storms, tropical cyclones, and hurricanes).

15.1.14.2. 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)

[142] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents ($MMTCO_2e$). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_2e$ = (million metric tons of a gas) * (GWP of the gas)." (USEPA, 2016f)

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_2, CH_4, N_2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, which is in accordance with Section 19 (m) of *Executive Order 13693*. The final CEQ guidance suggests that agencies consider "(1) the potential effects of a proposed action on climate change as indicated by assessing GHG emissions (e.g. to include, where applicable, carbon sequestration); and (2) the effects of climate change on a proposed action and its environmental impacts." The final guidance recommends that agencies quantify an action's projected direct and indirect GHG emissions when data inputs are reasonably available to support calculations. The final guidance states that "agencies should be guided by the principle that the extent of the analysis should be commensurate with the quantity of the projected GHG emissions and take into account available data and GHG quantification tools that are suitable for and commensurate with the proposed agency action." In addition, CEQ recommends agencies evaluate project emissions and changes in carbon sequestration and storage, when appropriate, in assessing a proposed action's potential climate change impacts. The analysis should assess direct and indirect climate change effects of a proposed project including connected actions, the cumulative impacts of its proposed action, and reasonable alternatives. CEQ advises that climate change effects on the environmental consequences of a proposed action should be described based on available studies, observations, interpretive assessments, predictive modeling, scenarios, and other empirical evidence. The temporal bounds should be limited by the expected lifetime of the proposed project. Mitigation and adaptation measures should be considered in the analysis for effects that occur immediately and in the future. The TCEQ has developed a GHG PSD permitting program. In addition, several cities within Texas have developed policies or regulations to combat climate change as shown in Table 15.1.14-1 and following text.

Table 15.1.14-1: Relevant Texas Climate Change Laws and Regulations

State Laws/Regulations	Regulatory Agency	Applicability
Mayor's National Climate Action Agenda	City of Houston	Houston's Mayor Parker helped form the "Mayors' National Climate Action Agenda," which establishes several key elements that cities and Mayor's commit to when joining the Climate Action including establishing, or renewing, an existing aggressive GHG emissions reduction target for both the near term (i.e., by 2020 or sooner) and long term (e.g., 80% reductions by 2050).
Resolution 20140410-024 (April 2014)	City of Austin	On April 10, 2014, Austin City Council passed Resolution 20140410-024, which establishes a new long-term goal of reaching net zero community-wide GHG emissions by 2050, or earlier. On June 4, 2015, City Council passed a resolution which adopts the Austin's Community Climate Plan and gives additional direction on next steps.

Sources: (MNCAA, 2017), (City of Austin, 2014)

15.1.14.3. Greenhouse Gas Emissions

Estimates of Texas' total GHG emissions vary. The Department of Energy's (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as methane (CH_4) and nitrous oxide (NO_x), 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, 2014c). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

For the purposes of this PEIS, the EIA data on CO_2 emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH_4, they are described and cited.

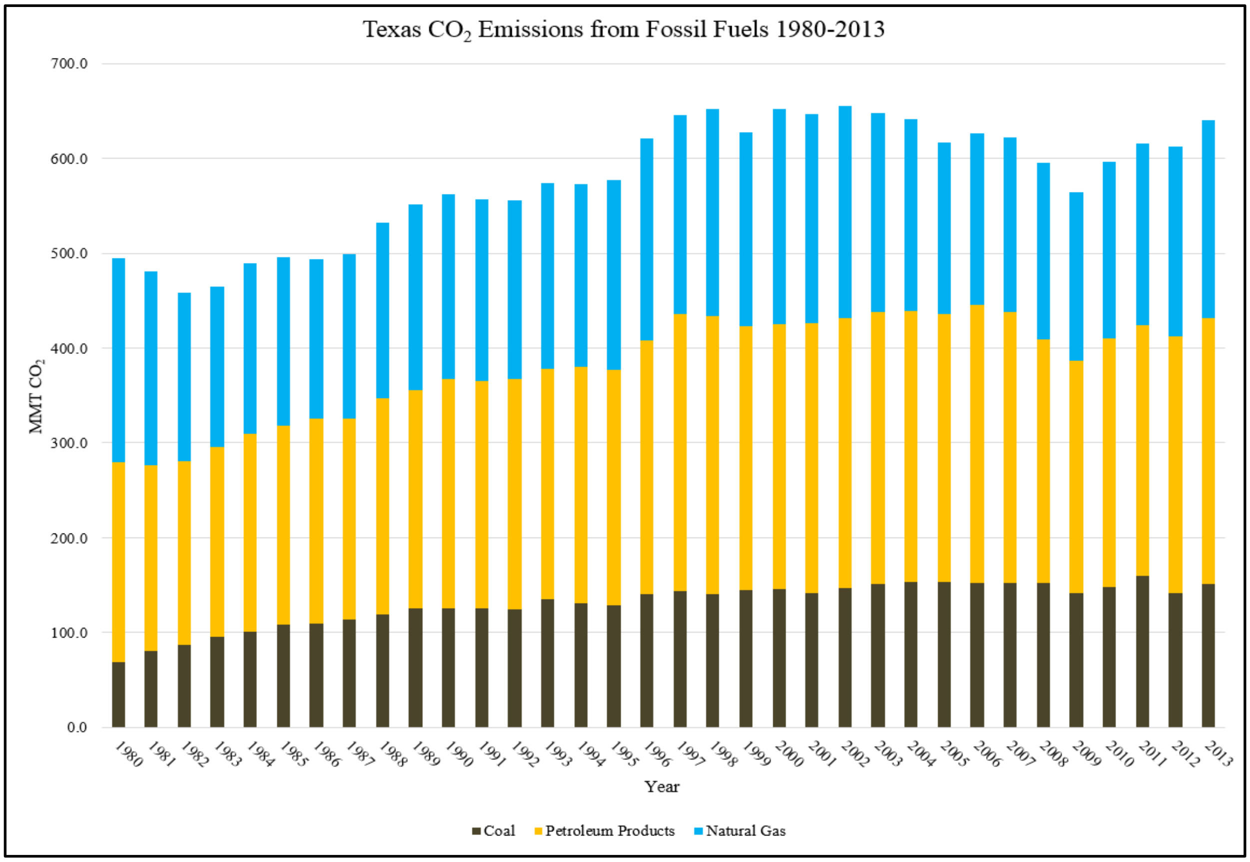
As of 2014, Texas was the largest emitter of CO_2 in the United States (EIA, 2014b). According to the EIA, Texas emitted a total of 641.7 million metric tons (MMT) of CO_2 in 2014. The two largest emitting sectors, transportation and electric power, each emitting approximately 35 percent of the total, respectively. The industrial sector emitted close to 26 percent (Table 15.1.14-2) (EIA, 2016b) Annual emissions between 1980 and 2013 are presented in Figure 15.1.14-1 (EIA, 2014b). Between 1980 and 2002, Texas' CO_2 emissions increased by approximately 33 percent to a maximum of 655.9 MMT. Emissions then declined to 556.8 MMT in 2009 before increasing to their 2014 levels. Texas is ranked 15th among the 50 states and the District of Columbia for per-capita energy-related GHG emissions in 2014 (EIA, 2014b).

Additionally, the City of Dallas decided to purchase electric power from renewable sources that do not use fossil fuel. The City of Dallas has committed to purchase 50 percent of the electric power used by City facilities from wind power, which will keep about 266,000 tons of CO_2 out of the atmosphere. (City of Dallas, 2013)

Table 15.1.14-2: Texas CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2014

Fuel Type (MMT)		Source (MMT)	
Coal	149.8	Residential	13.9
Petroleum Products	279.1	Commercial	12.1
Natural Gas	212.9	Industrial	169.2
		Transportation	221.7
		Electric Power	224.8
TOTAL	**641.7**	**TOTAL**	**641.7**

Source: (EIA, 2014c)



Source: (EIA, 2014c)

Figure 15.1.14-1: Texas CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Texas has not conducted a state-level greenhouse gas emission inventory. Texas' GHG emissions profile is probably dominated by CO_2 due to the nature of its primary industries (oil and gas as well as electricity generation (EIA, 2015d)). Texas has the 2nd largest economy of the U.S., and 2nd largest population after California, and due to its size and access to natural resources, it is a significant electricity consumer and producer (EIA, 2015d). Unlike other states, Texas is energy self-sufficient and does not rely on surrounding states for resources such as coal or natural gas (EIA, 2015d). Of the 100 largest gas fields in the United States, one-third are located in Texas. Texas is also a leading crude oil refiner and with 27 refineries. Production began in first oil boom in the 1900s, peaked and began to decline in 1972, but then began to grow again in 2008 due to improvements in production technology (EIA, 2015d).

15.1.14.4. Environmental Setting: Existing Climate

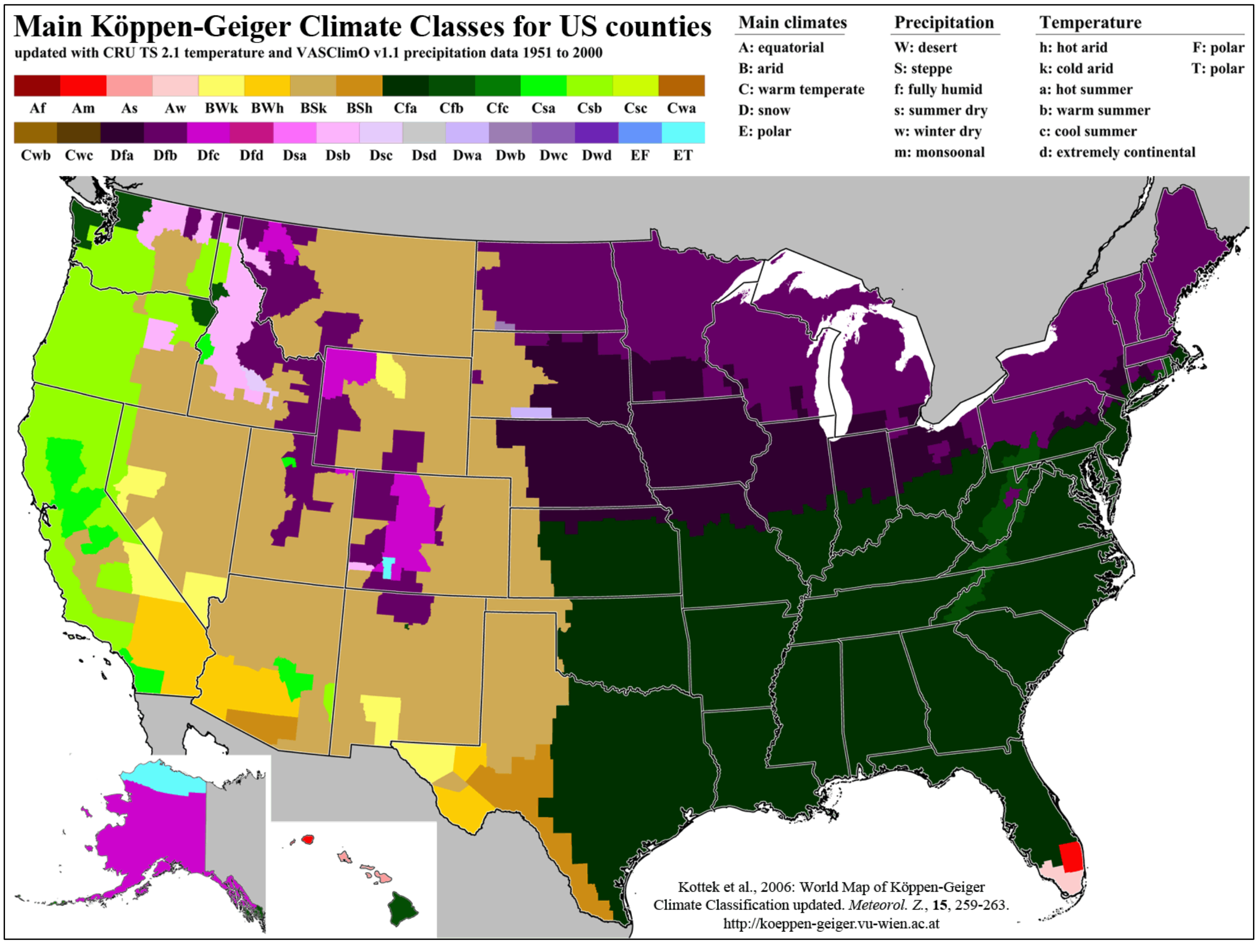
The National Weather Service defines climate as "The composite or generally prevailing weather conditions of a region, throughout the year, averaged over a series of years." (NOAA, 2009b). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2006).

The entire eastern half of Texas, including half of the southern peninsula, 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, 2011a). During summer months, thunderstorms are frequent. Areas of southern, northern, and western Texas fall into climate group (B). Climates classified as (B) are dry climates, “in large continental regions of the mid-latitudes often surrounded by mountains” (NWS, 2011a). “The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation” (NWS, 2011a). Texas has five sub-climate categories, which are described in the paragraphs below.

Cfa – The Köppen-Geiger climate classification system classifies the large regions of eastern, northern, and southern Texas as Cfa. Cfa climates are generally warm, with humid summers and mild winters. In this climate classification zone, the secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. In this climate classification zone, the tertiary classification indicates mild, hot summers with average temperature of warm months over 72 °F. Average temperatures of the coldest months are under 64 °F. (NWS, 2011a) (NWS, 2006)

BWk – The Köppen-Geiger climate classification system classifies portions of western Texas as BWk. Climates classified as BWk are mid-latitude deserts, with mean annual temperatures that are less than 64 ºF and are too dry to support most plant life. Evaporation in BWk climates “exceeds precipitation on average but is less than half potential evaporation” (NWS, 2006). Winters in BWk climates zones typically experience “below freezing temperature” (NWS, 2006). (GLOBE SCRC, 2015)

BWh – The Köppen-Geiger climate classification system classifies portions of western Texas as BWh. Climates classified as BWh are subtropical, desert climates with arid, hot, and desert-like conditions. Mean annual temperatures in BWh climates are greater than or equal to 64.4 ºF. BWh climates are too dry to support most plant life. Frost in BWh climates is absent or infrequent. (GLOBE SCRC, 2015) (NWS, 2011a) (NWS, 2006)



Source: (Kottek, World Map of the Köppen-Geiger Climate Classification, 2006)

Figure 15.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Bsk – The Köppen-Geiger climate classification system classifies areas of northern and west central Texas as Bsk. Climates classified as Bsk, are mid-latitude and dry. "Evaporation exceeds precipitation on average but is less than potential evaporation" (NWS, 2006). Average temperatures in Bsk climate zones are less than 64 °F. (NWS, 2011a) (NWS, 2006)

BSh – The Köppen-Geiger climate classification system classifies portions of central, southern, and western Texas as BSh. Climates classified as BSh are subtropical, dry, steppe climates. Mean annual temperatures in BSh climates are greater than or equal to 64 °F. BSh climates are too dry to support a forest and generally consist of grassland plains. BSh climates are not considered desert climates, due to the amount of moisture they receive. (GLOBE SCRC, 2015) (NWS, 2011a) (NWS, 2006)

Air Temperature

Texas is the largest state in the contiguous 48 states, "with its land area of 261,914 miles roughly equal in size to all the states bordering the Atlantic Ocean from Maine to North Carolina" (Nielsen-Gammon, 2015). Although Texas has several different sub-climate categories, one thing that the state has in common is that each region can get very hot. During exceptionally warm summers, daily temperatures can exceed 110 ºF. The greatest temperature to occur in Texas was on August 12, 1936 and June 28, 1994 with a record high of 120 ºF in Seymour and Monahans respectively (SCEC, 2015). The lowest temperature to occur in Texas was on February 8, 1933 with a record low of negative 23 ºF in Seminole (SCEC, 2015). In Wichita, during a particularly warm summer, the temperature reached 110 ºF for 10 consecutive days. (Nielsen-Gammon, 2015)

The following paragraphs describe temperature variations as they occur within Texas' various climate classification zones:

Cfa – Austin, the capital of Texas, is located within the climate classification zone Cfa. The average annual temperature in Austin is approximately 67.3 ºF; 50.5 ºF during winter months; 82.7 ºF during summer months; 67.2 ºF during spring months; and 68.4 ºF during autumn months (NOAA, 2015g).

BWk – El Paso, located in western Texas, is within the climate classification zone BWk. The average annual temperature in El Paso is approximately 64.6 ºF; 46.6 ºF during winter months; 81.9 ºF during summer months; 65.1 ºF during spring months; and 64.6 ºF during autumn months (NOAA, 2015g).

BWh – Terlingua, located in southwestern Texas, is within the climate classification zone BWh. The average annual temperature in Terlingua is approximately 65.5 ºF; 49.6 ºF during winter months; 79.7 ºF during summer months; 66.9 ºF during spring months; and 65.9 ºF during autumn months (NOAA, 2015g).

Bsk – Amarillo, located in northern Texas, is within the climate classification zone Bsk. The average annual temperature in Amarillo is approximately 57.4 ºF; 38.0 ºF during winter months; 76.5 ºF during summer months; 56.6 ºF during spring months; and 58.0 ºF during autumn months (NOAA, 2015g).

BSh – Laredo, located on Texas' southern peninsula, is within the climate classification zone BSh. The average annual temperature in Laredo is approximately 74.2 ºF; 58.2 ºF during winter months; 87.8 ºF during summer months; 75.6 ºF during spring months; 74.9 ºF during autumn months (NOAA, 2015g).

Precipitation

Precipitation in Texas varies significantly from east to west, "as a near-desert climate exists in the Trans-Pecos region of the Far West Texas that gradually gives way to a subtropical, humid climate to the East" (Nielsen-Gammon, 2015). Precipitation across Texas is also commonly described as either "feast or famine," which has led to several instances of drought and flooding across the state. Due to the large size of the state, "it is not unusual to see one region of Texas with drought conditions while another region is dealing with excessive rainfall" (Nielsen-Gammon, 2015). For example, Alvin, located east of Houston, "set the 24-hour precipitation record for the continental United States on July 25-26, 1979 with 42" of rainfall" (Nielsen-

Gammon, 2015). By comparison, the town of Imperial, located in the Trans-Pecos area, only saw 1.3 inches of rainfall in 1953. (Nielsen-Gammon, 2015)

Regions of far eastern Texas typically receive the greatest rainfall amounts in the state, with an average of 50 to above 54 inches. Areas of east central and central Texas receive between 26 and 50 inches annually, while areas of western Texas can receive as little as 14 inches or less. The greatest 24-hour snowfall occurred on March 28, 2009 with a total of 25 inches in Follett (SCEC, 2015). (Nielsen-Gammon, 2015) (PRISM, 2015)

The following paragraphs describe precipitation as it occurs within Texas' various climate classification zones:

Cfa – Austin, the capital of Texas, is located within the climate classification zone Cfa. The average annual precipitation accumulation in Austin is approximately 32.15 inches; 6.85 inches during winter months; 8.46 inches during summer months; 55.0 inches during spring months; and 55.6 inches during autumn months (NOAA, 2015g).

BWk – El Paso, located in western Texas, is within the climate classification zone BWk. The average annual precipitation accumulation in El Paso is approximately 9.71; 1.64 inches during winter months; 4.50 inches during summer months; 0.96 inches during spring months; 2.61 inches during autumn months (NOAA, 2015g).

BWh – Terlingua, located in southwestern Texas, is within the climate classification zone BWh. The average annual precipitation accumulation in Terlingua is approximately 12.13 inches; 1.30 inches during winter months; 5.65 inches during summer months; 1.70 inches during spring months; and 3.48 inches during autumn months (NOAA, 2015g).

Bsk – Amarillo, located in northern Texas, is within the climate classification zone Bsk. The average annual precipitation accumulation in Amarillo is approximately 20.36 inches; 1.99 inches during winter months; 8.91 inches during summer months; 5.08 inches during spring months; and 4.38 inches during autumn months (NOAA, 2015g).

BSh – Laredo, located on Texas' southern peninsula, is within the climate classification zone BSh. The average annual precipitation accumulation in Laredo is approximately 20.20 inches; 2.72 inches during winter months; 6.12 inches during summer months; 5.03 inches during spring months; and 6.33 inches during autumn months (NOAA, 2015g).

Sea Level

Texas has approximately 397 miles of coastline, with 3,359 miles of tidal shoreline. Much of this shoreline is at risk for damage from strong winds, heavy rainfall, flooding, and tropical storms and/or hurricanes. Since 1900, approximately 8 inches of "warming-driven global seal level rise" has occurred, with approximately 0.07 inches of rise occurring per year (Climate Central, 2014) (The Union of Concerned Scientists, 2013a). Galveston in particular has experienced accelerated sea level rise, with approximately 36 inches in sea level rise since 1880, due to a combination of global warming and land subsidence (The Union of Concerned Scientists, 2013b). As sea level continues to rise, the risks associated with living along the coast also rise. Higher sea levels also give way to higher storms surges, and potentially more damage from coastal and tidal flooding. Hurricane Katrina in 2005 and Superstorm Sandy in 2012 highlighted the risks and vulnerabilities of living near unprotected tidal shoreline. (The Union of Concerned Scientists, 2013a) (The Union of Concerned Scientists, 2013b)

Severe Weather Events

In June 2001, "Tropical Storm Allison dumped as much as 35 [inches]" of rain in the Houston area, and the resulting flooding caused over $5 billion in damages" (Nielsen-Gammon, 2015). During this storm, Tropical Storm Allison produced rainfall totals that reached 18 inches in a single 24-hour period over a large portion of southeast Texas. After the storm, many stations reported a total of 40 inches in rainfall accumulation. Over 2 million people in Texas were impacted, 23 people were killed, and over 700,000 residents experienced significant or unrepairable damage to their homes. Due to this storms extreme destruction, the name Allison was retired. "Tropical Storm Allison is the only tropical cyclone to have its name retired without reaching hurricane strength" (NWS, 2015). The following year, in June and July of 2002, a 500-year flooding event impacted a large area of South Central Texas. Having barely recovered from the previous 500-year flooding event, just 4-years prior, the area was hit with heavy rain that fell continuously over an 8-day period. On July 1, 2002, San Antonio International Airport reported a total accumulation of 9.52 inches. This total in San Antonino stands as the 1-day record for the month of July in Texas. By July 6, 2002, flash flooding in the area had extended as far north as Abilene, over 175 away from the heaviest axis of rainfall. Several counties in the area, including Hill and San Antonia, relieved between 25 and 35 inches of rainfall during this storm. The highest rainfall accumulation total recorded was in Kendall County, with 45.1 inches. In total, 12 people were killed, approximately 48,000 homes were damaged, and monetary losses exceeded $1B. In addition, 24 counties were declared federal disaster areas. (Nielsen-Gammon, 2015) (NWS, 2015)

During another significant flooding event, Hurricane Ike hit Galveston Island on September 13, 2008. During this storm, wind speeds reached up to 110 miles per hour (mph), more than 20 inches of precipitation fell over some areas, and the associated storm surge reached over 20 feet. In total, this storm caused over $20B in damages and is remembered as the 3rd most costly storm in U.S. history. The deadliest U.S. severe weather disaster also occurred on Galveston Island, in which a Category 4 Hurricane struck in 1900, killing 8,000 people. (Nielsen-Gammon, 2015)

To date, Texas ranks the highest in tornado occurrences of any other state with an average of 155 between the period of 1991 and 2010 (NOAA, 2015h). Although the exact boundaries of tornado alley are debatable, generally, "the region from central Texas, northward to northern Iowa, and from central Kansas and Nebraska east to western Ohio is often collectively known as Tornado Alley" (NOAA, 2015i). The deadliest tornado to touch down in Texas and the sixth deadliest tornado to occur in the U.S., touched down as an F-5 tornado on April 9, 1947. In total, 181 people were killed and 970 people were injured across three states: Texas, Kansas, and Oklahoma (NOAA, 2015j). This tornado was also one of the largest tornadoes to ever touch down in Texas, tearing through the Texas Panhandle and staying on the ground for 221 miles, finally dissipating in Kansas. In Texas alone, the deadliest tornado to occur was on May 11, 1953 in Waco, killing 114 people and injuring 597. (Nielsen-Gammon, 2015)

Drought is Texas can also be common, particularly in western and central regions of the state. One of the state's most severe droughts occurred between 2008 and 2009. By comparison, this drought was determined to be the most severe on record for Bastrop, Caldwell, and Lee Counties. When including the impacts of unusually high temperatures, this drought is also considered the most severe on record for Victoria, Bee, San Patricio, Live Oak, Jim Wells, and Duval Counties. Although the drought of 1956 was longer in duration, the intensity of the drought was not as extreme as the 2008 through 2009 drought. (Office of the State Climatologist, 2009)

Another severe drought, which is unprecedented in many areas of the state, occurred in 2011, one year a relatively wet season. During this drought, "a record dry March through May was followed by a record dry June through August" (Nielsen-Gammon, 2011). In addition, "the 12-month rainfall total for October 2010 through September 2011 was far below the previous record set in 1956" (Nielsen-Gammon, 2011). In addition to extremely low precipitation accumulations, average temperatures in Texas this year were approximately 2 ^{o}F above the previous Texas record and were "close to the warmest statewide summer temperatures ever recorded in the United States" (Nielsen-Gammon, 2011).

15.1.15. Human Health and Safety

15.1.15.1. 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 or vehicle traffic and the transportation of hazardous materials and wastes evaluated in Section 15.1.1.

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 Centers for Disease Control and Prevention website at www.CDC.gov.

15.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Texas, this resource area is regulated by the Texas Workforce Commission (TXWC), and the Texas Commission of Environmental Quality (TCEQ). Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Texas does not have an OSHA-approved "State Plan," therefore, private and public sector occupational safety and health programs in Texas are enforced by OSHA. Public health is regulated by the Texas Department of State Health Services (TXDSHS).

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 15.1.15-1 below summarizes the major Texas laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 15.1.15-1: Relevant Texas Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
TAC: Title 30, Part 1, Chapter 330	TCEQ	Regulated all aspects of municipal solid waste management, including collection, landfills, groundwater monitoring, and closure and post-closure activities.
TAC: Title 30, Part 1, Chapter 333	TCEQ	Establishes the Voluntary Cleanup Program with incentives to remediate brownfields and create a voluntary response process.
TAC: Title 30, Part 1, Chapter 335	TCEQ	Establishes an assessment and remediation program to identify facilities that may present a risk to public health from release of hazardous substances.
TAC: Title 30, Part 1, Chapter 350	TCEQ	Establishes the Texas Risk Reduction Program, which establishes response action requirements for the TCEQ remediation program.
TS, Health and Safety Code: Title 6, Chapter 502	Texas Department of State Health Services (TXDSHS)	Outlines the Hazard Communication Act and requires employers to provide hazardous chemical information to employees.
TS, Natural Resources Code: Title 4, Chapter 131	Railroad Commission of Texas	Establishes the Uranium Surface Mining and Reclamation Act to ensure the reclamation of uranium-mined land.
TS, Natural Resources Code: Title 4, Chapter 134	Railroad Commission of Texas	Establishes the Texas Surface Coal Mining and Reclamation Act to ensure the reclamation of all surface coalmines.

Sources: (TX SOS, 2017e), (TX SOS, 2017f), (TX SOS, 2017g), (TCEQ, 2016b), (TX SOS, 2017h), (Texas Legislature, 2001), (Texas Legislature, 2007), (Texas Legislature, 1995)

15.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites. Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or in confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016a). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground's surface (OSHA, 2015). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes[143] 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 movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics.

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a telecommunication site, heavy equipment such as bulldozers, backhoes, dump trucks, cement trucks, and cranes are used to prepare the ground, transport materials and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks as telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator.

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work.

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination

[143] 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.

and splicing activities, and can penetrate exposed skin (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 dB per 8-hour time weighted average (see Section 15.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area.

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require 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.

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.

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings.

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry

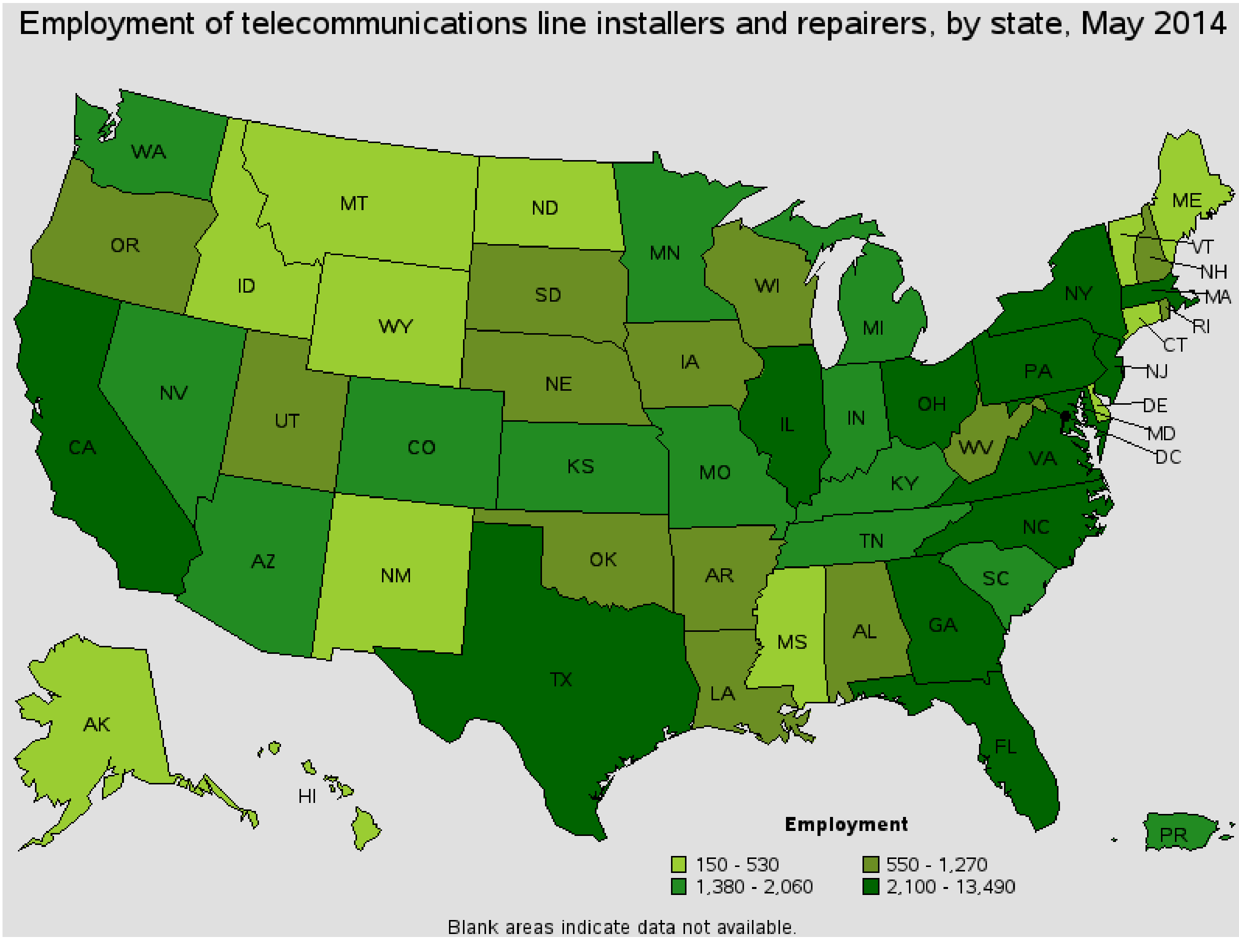
(NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as either telecommunication equipment installers and repairers, except line installers (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 20,520 telecommunication equipment installers and repairers, and 8,780 telecommunication line installers and repairers (Figure 15.1.15-1) working in Texas (BLS, 2015c). In 2013, the most recent year data are available, Texas had 1.1 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; 7 due to slips, trips, or falls; and 3 due to unknown causes), 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). Texas had four fatalities each in 2003 and 2005, and three fatalities in 2013 within the telecommunications industry (NAICS code 517). Within the telecommunications line installers and repairers occupation (SOC code 49-9052), Texas had three occupational fatalities each in 2010, 2012, 2013, and 2014. By comparison, within the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 464 fatalities in Texas between 2003 and 2014, with the highest fatality year being 2014, with 60 fatalities (BLS, 2015d).

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. TXDSHS collects environmental and public health data through the Texas Health Data web-based query system (Texas Department of State Health Services, 2015). The same data are reported with more specificity at the federal level through the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, in Texas, between 1999 and 2013, there were 606 fatalities due to a fall from, out of, or through a building or structure; 118 fatalities due to being caught, crushed, jammed or pinched in or between objects; and 115 fatalities due to exposure to electric transmission lines (CDC, 2013). 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 15.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

15.1.15.4. 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[144] 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

[144] 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).

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 Texas Superfund Program is administered by TCEQ, and addresses public health and safety risks at contaminated sites with state funds (TCEQ, 2015o). As of December 2015, Texas had 254 RCRA Corrective Action sites,[145] 688 brownfield sites, and 51 proposed or final Superfund/NPL sites (USEPA, 2015j). Based on a December 2015 search of USEPA Cleanups in My Community (CIMC) database, there is one Superfund site (Jones Road Ground Water Plume near Houston, TX) (USEPA, 2015k) and no RCRA Corrective Action sites (USEPA, 2015l) in Texas where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists.

Brownfield sites in Texas may be enrolled in the Brownfield Site Assessment Program for redevelopment assistance (TCEQ, 2015p). In addition, the Texas Voluntary Cleanup Program provides legal incentives to encourage remediation of contaminated sites by non-responsible parties (TCEQ, 2014d). One example of a brownfield site is the Crestview Station site, a 71-acre former chemical research facility in central Austin. Following cleanup actions, the site was redeveloped into a mixed-use development with residences, parks, offices, and commercial areas, as well as a light rail stop (TCEQ, 2015q).

Uranium mining and milling activity in Texas presents unique health and safety hazards to the general public and potentially to occupational workers installing infrastructure on contaminated land. Uranium extraction produces mill tailings, a radioactive ore residue containing heavy metals and radium that presents radiation exposure through airborne decay products or in water supplies. In 2006, the USEPA compiled over 4,000 federal, state, and tribal uranium mine records to identify potential problem areas. However, the location of many uranium sites remains unknown since uranium was not always the primary mined material, and abandoned mines may not have been assessed for potential radioactive hazards such as tailings. (USEPA, 2006) Presently, there are no active surface uranium mines in the State of Texas, but exploration for in situ uranium mining is regulated by the Railroad Commission of Texas, Surface Mining and Reclamation Division (Railroad Commission of Texas, 2015a). As of November 2015, there were 13 active uranium exploration permittees registered in Texas (Railroad Commission of Texas, 2015b). In situ uranium mining is regulated by the TCEQ (TCEQ, 2015r).

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 TRI 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

[145] Data gathered using USEPA's CIMC search on December 8, 2015, for all sites in Texas, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013b).

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 December 2015, Texas had 1,766 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, Texas released 227.1 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the chemicals, hazardous waste, and electric utilities industries. This accounted for 5.54 percent of nationwide TRI releases, ranking Texas 24st of 56 U.S. states and territories based on total releases per square mile. (USEPA, 2013e)

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities that do not comply with environmental regulations and violate their permit requirements have the potential to be harmful to human health or the environment. As of November 12, 2015, Texas had over 500 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015m).

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 15.1.15-2 provides an overview of potentially hazardous sites in Texas.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of December 2015, there are nine USEPA-regulated telecommunications sites in Texas (USEPA, 2015n). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, since 2003, Texas had one fatality in 2013 within the telecommunications line installers and repairers occupation (SOC code 49-9052) from exposure to "harmful substances or environments" (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), therefore hazards relating to mines will not be discussed further.

Public Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of December 2015, there are nine USEPA-regulated telecommunications sites in Texas (USEPA, 2015n). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

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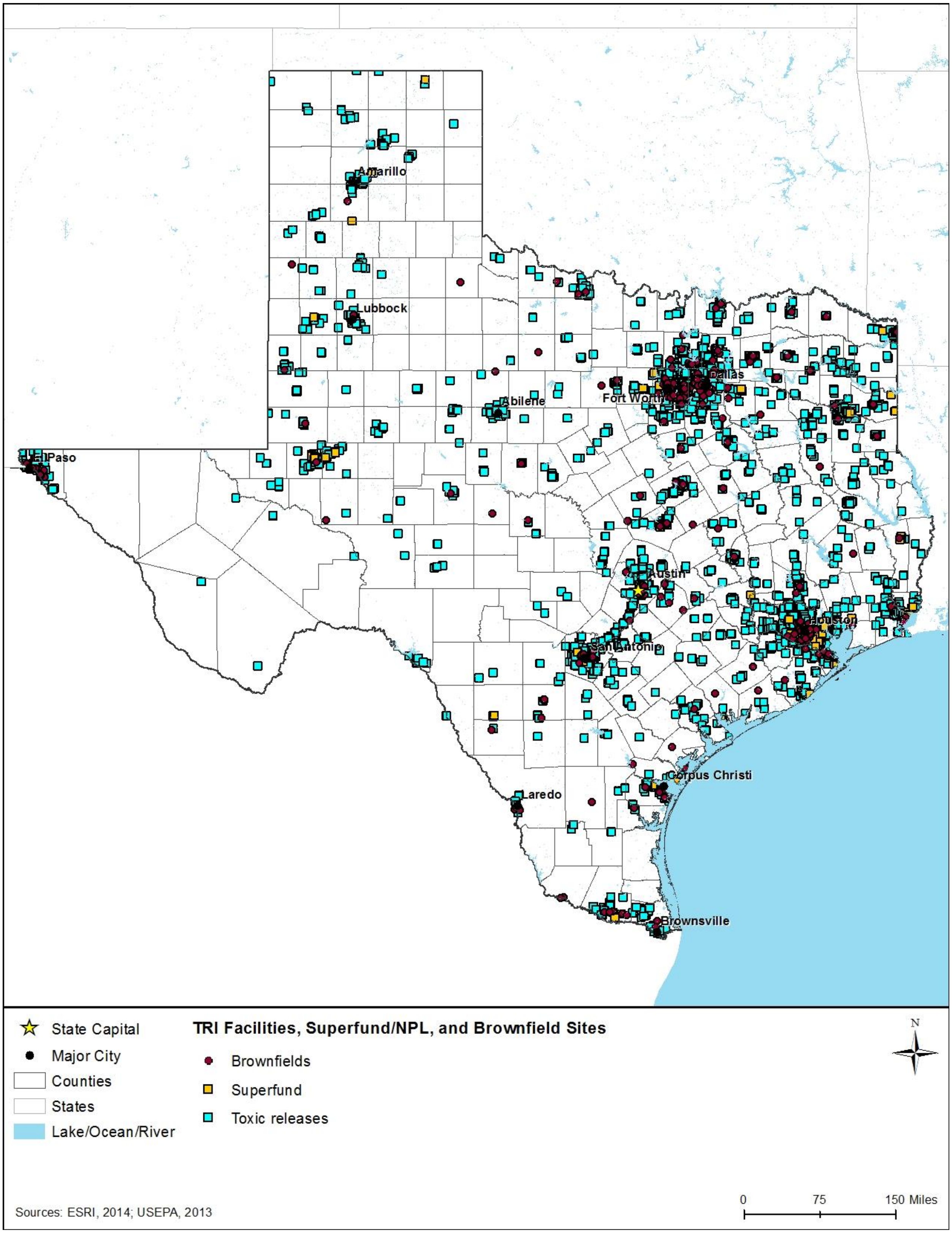
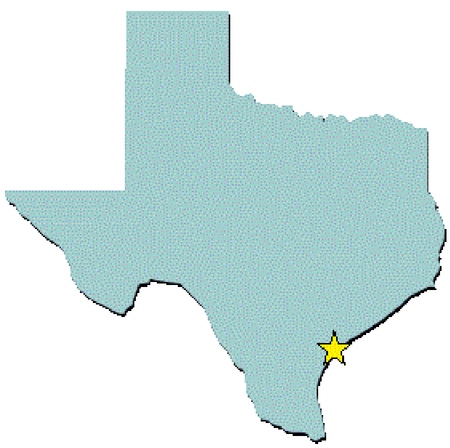


Figure 15.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Texas (2013)

Spotlight on Texas Superfund Sites: Falcon Refinery Site

The Falcon Refinery site is a 104-acre former crude oil refinery in Ingleside, TX (San Patricio County), which began operation in 1980 (**Error! Reference source not found.**). The factory p rocessed crude oil into jet fuel, kerosene, diesel, and fuel oil at a rate of almost 40,000 barrels per day. Crude oil and refined product were transferred between the refinery and nearby barges on the intercoastal waterway. (USEPA, 2015o)

In 1986, nearby residents began complaining of odors from the refinery, and an inspection by the Texas Water Commission discovered the disposal of sludge and untreated wastewater on-site. In 1987, a USEPA inspection revealed a breach in a containment dike, from which runoff potentially impacted nearby wetlands. The USEPA sampling in May 2000 found five sources of contamination at the site. The Agency for Toxic Substances and Disease Registry (ATSDR) listed the Falcon Refinery site as an "indeterminate public health hazard," and recommended additional sampling to better characterize the contamination. (ATSDR, 2009)



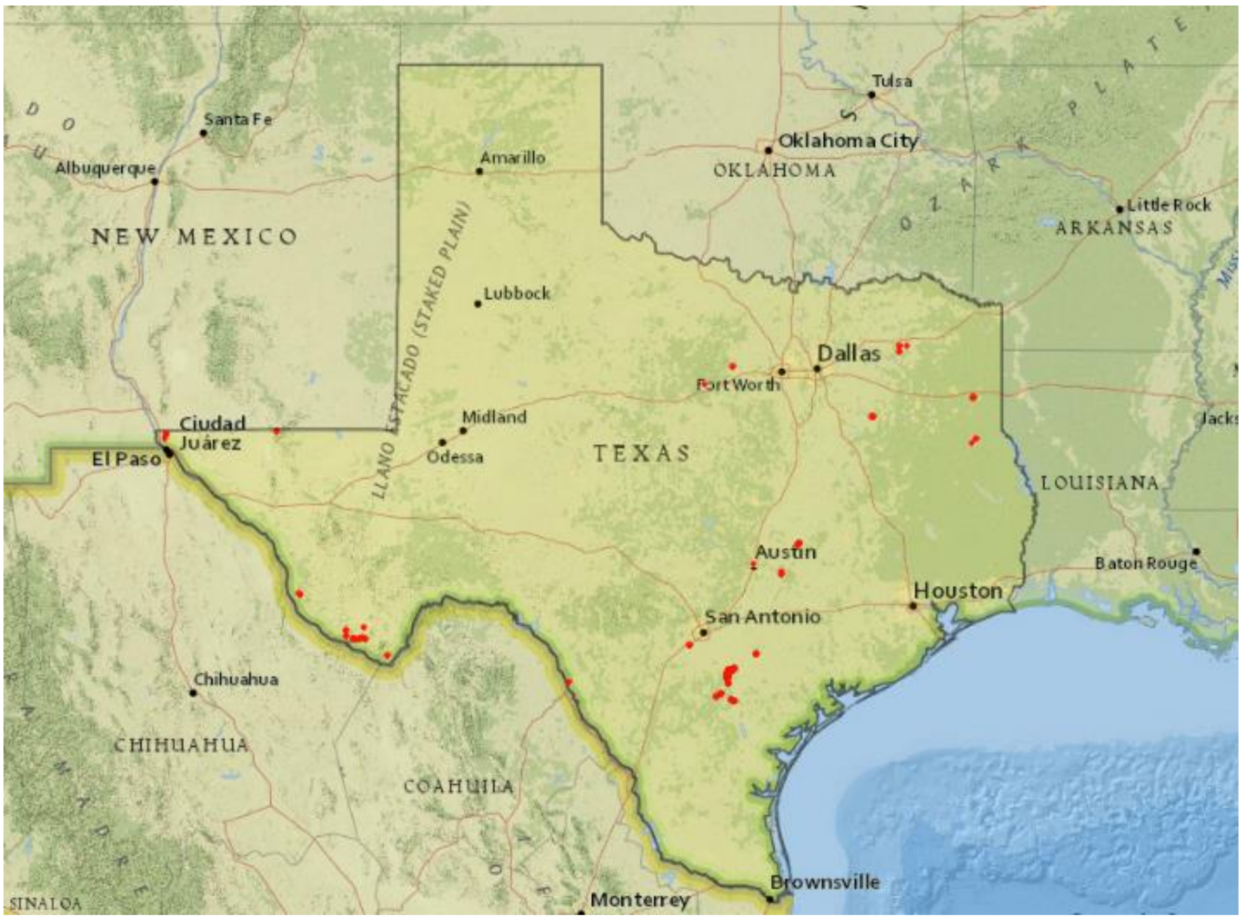
Source: (The Aransas Pass Progress, 2011)

Figure 15.1.15-3: Entrance to Falcon Refinery Superfund Site, Ingleside, Texas

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

Another health and safety hazard in Texas includes surface and subterranean mines, including uranium mines. In 2015, the Texas mining industry ranked 3rd for non-fuel minerals (portland cement, crushed stone, construction sand and gravel, industrial sand and gravel, and salt), generating a value of $5.3B (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 (BLM, 2015).

The Railroad Commission of Texas, Surface Mining and Reclamation Division administers the Abandoned Mined Land Program, and is responsible for managing AML health and safety hazards at pre-1977 mining sites. The AML program has completed reclamation of all known Priority 1 & 2 coalmine AML sites in Texas, and is presently focusing on reclaiming abandoned surface uranium mines and abandoned underground hardrock mines. (Railroad Commission of Texas, 2015c) Figure 15.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Texas, 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, Texas had 58 Priority 1 and 2 AMLs, with 20 unfunded problem areas (USDOI, Office of Surface Mining Reclamation and Enforcement, 2015a).



Source: (USDOI, Office of Surface Mining Reclamation and Enforcement, 2015b)

Figure 15.1.15-4: High Priority Abandoned Mine Lands in Texas (2015)

Additional hazards found in Texas include contamination from the oil and gas industry. Texas ranks first in the United States for oil production, generating 35 percent of U.S. crude oil, primarily from the Eagle Ford formation. However, production growth between 2010 and 2013 was the second fastest in the nation, at 119 percent (EIA, 2013). Health and safety hazards associated with oil and gas exploration include both direct and indirect groundwater contamination, as well as hazardous air emissions from both stationary and mobile sources. For example, in March 2014, a ship and an oil-tank barge collided in Galveston Bay, spilling approximately 168,000 gallons of fuel oil into the water. Cleanup actions were conducted before the spilled oil could cause excessive ecological harm. (NOAA, 2008)

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. 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.

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 (USDOI, Office of Surface Mining Reclamation and Enforcement, 2015c).

15.1.15.6. Environmental Setting: Natural & Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the 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). In Texas, natural or manmade disasters could result in an uncontrolled release of radioactive material from abandoned and in situ uranium mines, increasing potential risk to health and safety.

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 early responders to natural and manmade disasters 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, TXDSHS 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 1,897 NRC-reported incidents for Texas in 2015 with known causes, 143 were attributed to natural disaster (flood, natural phenomenon, and tornado), and 1,754 were attributed to manmade causes (such as equipment failure and operator error) (USCG, 2015). For example, during Hurricane Ike in 2008, the storm surge submerged six fuel storage tanks, causing damage and a release of approximately 6,337 barrels of crude oil at the St. Mary Land and Exploration Company's onshore production facility in Galveston, TX (USCG, 2008). Response workers may come in to contact with contaminated waters in flooded areas near telecommunication sites, such as roadside ditches and culverts. Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters.

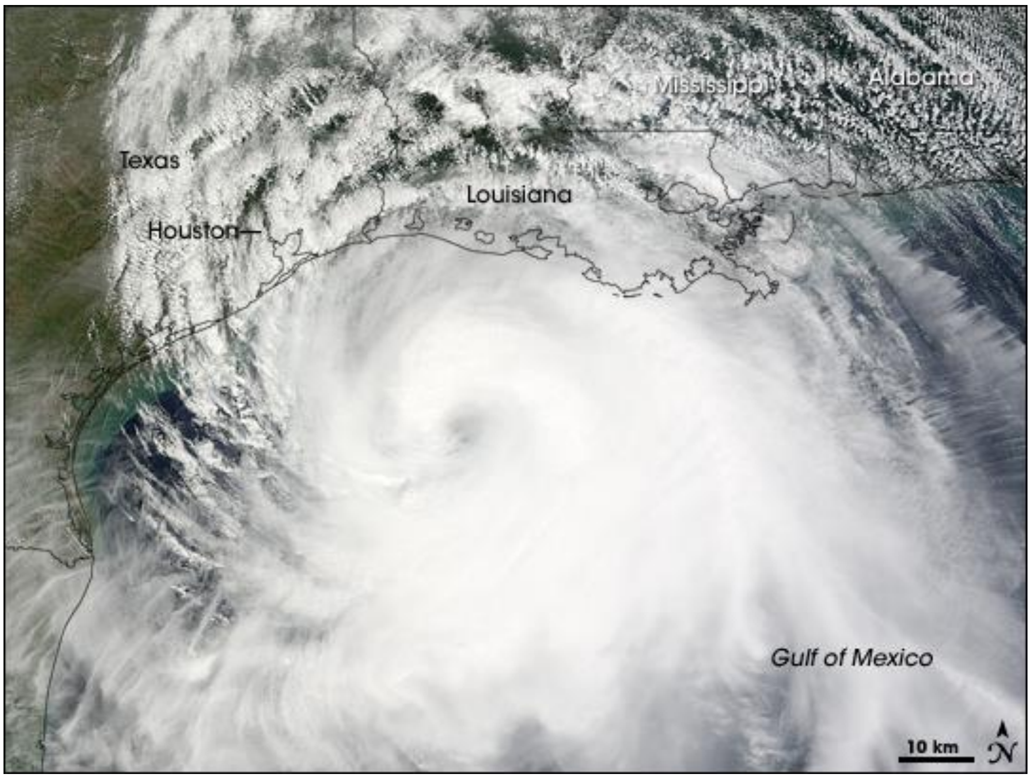
Public Health and Safety

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, Texas had 10 weather-related fatalities (6 due to flooding, 1 due to lightning, 1 due to wind, and 2 due to unknown causes) and 58 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NOAA, 2014d)

Spotlight on Texas Natural Disaster Sites: Hurricane Ike

In early September 2008, Hurricane Ike formed from a tropical depression east of Puerto Rico. After crossing Cuba, the storm grew to a Category 2 hurricane in the warm waters of the Gulf of Mexico before making landfall on September 13 near Galveston, TX (Figure 15.1.15-5) (NOAA, 2008).

The hurricane interrupted electrical service for two million people and caused widespread flooding in coastal communities. The state estimated $89.2 million to repair state and local infrastructure and $1.7B to repair damage to water and wastewater facilities and lines. Electric utility service was not fully restored in the region until late October. (FEMA, 2008)



Source: (NOAA, 2008)

Figure 15.1.15-5: Satellite Image of Hurricane Ike Before Making Landfall on September 13, 2008

15.2. 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, including 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.

15.2.1. Infrastructure

15.2.1.1. Introduction

This section describes potential impacts to infrastructure in Texas associated with construction, deployment, and operation of the Proposed Action and alternatives. Chapter 16, Best Management Practices 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.

15.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 15.2.1-1. As described in Section 15.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant*, *less than significant with mitigation measures incorporated*, *less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 15.2.1-1: 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 *potentially significant*, but with mitigation is *less than significant*.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	*No effect* on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is *potentially significant*, but with mitigation is *less than significant*.	Minor delays to access to care and emergency services that do not impact health outcomes.	*No impacts* on access to care or emergency services.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system ("brownouts"). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory,	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

15.2.1.3. 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., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 15.2.1-1, such impacts would be *less than significant* at the programmatic level due to the temporary nature of the construction activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience *less than significant* impacts at the programmatic level during construction or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, 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 15.2.1-1, potential negative impacts would be *less than significant* at the programmatic level. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 15.2.1-1, any potential impacts would be *less than significant* at the programmatic level during deployment.

As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience such beneficial impacts through enhanced communications abilities. In some cases, 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*. 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.[146] 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

At the programmatic level, the activities proposed by FirstNet would have *less than significant* impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

15.2.1.4. Potential Impacts of the Preferred Alternative

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

[146] Telecommunications equipment for specific spectrum use can be built where other equipment for other spectrum use already exists. If the new equipment and spectrum is not fully utilized, the geographic region may experience "over-build," where an abundance of under-utilized equipment may exist in that geographic location. This situation can be caused by a variety of factors including changes in current and future use patterns, changes in spectrum allocation, changes in laws and regulations, and other factors.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to infrastructure under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* to infrastructure resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes or disruption of transportation, telecommunications, or utility services.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would have *no impacts* on infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have *no impact* on infrastructure resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of points of presence (POPs),[147] huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase; however, it is anticipated that this tie-in would cause *less than significant* impacts at the programmatic level as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would not impact infrastructure resources, as noted above. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads, could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to

[147] Points of Presence are connections or access points between two different networks, or different components of one network.

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 COWs, COLTs, and SOWs are comprised 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 because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electric grid. These impacts are expected to be *less than significant* at the programmatic level as the deployment activities will likely be of short duration (generally a few hours to a few months depending on the activity), would be regionally based around the on-going phase of deployment, and minor. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its 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, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off 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 at the programmatic level as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[148]

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

[148] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to infrastructure even if deployment requires expansion of infrastructure, such as paving of previously unpaved surfaces or other new infrastructure built to support deployment. This is primarily due to the small amount of paving or new infrastructure that might have to be constructed to accommodate the deployables. The site-specific location of deployment would need to be considered, and any local infrastructure assets (transportation, telecommunications, or utilities) would need to be considered, planned for, and managed accordingly to try and avoid any negative impacts to such resources. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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 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 at the programmatic level would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to infrastructure at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.1, Infrastructure. The state also would not realize beneficial impacts to infrastructure resources described above.

15.2.2. Soils

15.2.2.1. Introduction

This section describes potential impacts to soil resources in Texas 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.

15.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 15.2.2-1. The categories of impacts are defined at the programmatic level as *potentially significant, less than significant with mitigation measures incorporated, less than significant*, or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

Table 15.2.2-1: 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 *potentially significant*, but with mitigation is *less than significant*.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

15.2.2.3. 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 Texas 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 Texas that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Albolls, Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Arents, Argids, Calcids, Cambids, Fluvents, Gypsids, Orthents, Saprists, Torrerts, Udalfs, Udepts, Uderts, Udolls, Udults, Ustalfs, Ustepts, Usterts, and Ustolls (see Section 15.1.2.4, Soil Suborders and Figure 15.1.2-2).

Based on the impact significance criteria presented in Table 15.2.2-1, 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 project, impacts to soils would be expected to be *less than significant* at the programmatic level given the short-term and temporary duration of the construction activities.

To the extent practicable, FirstNet would attempt to minimize ground disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures, where practicable and feasible, be implemented to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 16).

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 15.2.2-1, and due to the relatively small-scale (generally 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. Heavy equipment can cause perceptible compaction and rutting of susceptible soils. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 15.1.2.3, Soil Suborders). The most compaction susceptible soils in Texas are hydric soils with poor drainage conditions, which include Aqualfs, Aquents, Aquepts, Aquerts, Aquolls, Saprists, Udepts, Uderts, Usterts, and Ustolls. These suborders constitute approximately 47.1 percent of Texas' land area,[149] and are found across the state, particularly along coastal areas (see Figure 15.1.2-2). 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 15.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be *less than significant* at the programmatic level, due to the extent of susceptible soils in the state and the relatively small-scale (less than one acre) of most FirstNet projects. Potential impacts could be further reduced with the implementation of BMPs and mitigation measures.

15.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

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 would be through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures, and therefore 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,

[149] 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.

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 would 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 15.2.4, 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 nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes.

As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have *no impact* on soil resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: As stated above, collocation with no ground disturbance would result in *no impacts* to soil resources at the programmatic level. However, topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, lighting up of dark fiber in existing conduits or cables would have *no impact* on soil resources at the programmatic level, however, if installation of new huts or equipment we necessary, the activitycould 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 would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
    - Deployable Technologies: As stated above, if deployment occurred on paved surfaces or previously disturbed land, there would be *no impact* on soil resources, however, implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could result in soil compaction and rutting if deployed in unpaved areas. In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion,

topsoil mixing, or soil compaction and rutting. These impacts are expected to be *less than significant* at the programmatic level as the activity would likely be short term, localized to the deployment locations, and those locations would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities whenever feasible. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be *no impacts* to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to *be less than significant* at the programmatic level due to the temporary nature and small-scale of operations activities with the potential to create impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.2.5. 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 there would be *no impacts* at the programmatic level to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, *less than significant* soil compaction and rutting impacts 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. Therefore, there would be *no impacts* to soil resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.2, Soils.

15.2.3. Geology

15.2.3.1. Introduction

This section describes potential impacts to Texas 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.

15.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geological resources resources were evaluated using the significance criteria presented in Table 15.2.3-1. As described in Section 15.2, 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 geology addressed in this section are presented as a range of possible impacts.

Table 15.2.3-1: Impact Significance Rating Criteria for Geology at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMP 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 *potentially significant*, but with mitigation is *less than significant*.	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 *potentially significant*, but with mitigation is *less than significant*.	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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMP and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	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
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 *potentially significant*, but with mitigation is *less than significant*.	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

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMP and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMP 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 *potentially significant*, but with mitigation is *less than significant*.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

15.2.3.3. 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, landslides, and volcanic activity, 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.

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 15.1.3.8, Texas is not at risk to significant earthquake events. As shown in Figure 15.1.3-4, western Texas, including El Paso, is at a higher risk to earthquakes than the rest of the state, though no earthquake over magnitude 6.0 on the Richter scale has ever occurred in the state. Based on the impact significance criteria presented in Table 15.2.3-1, seismic impacts from deployment or operation of the Proposed Action would, at the programmatic level, have *no impact* on seismic activity; however, seismic impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for minor to moderate earthquakes in or near Texas, 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 Texas, as they do not occur in Texas; 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 15.1.3.8, the majority of Texas is at low risk of experiencing landslide events, although portions of eastern Texas are moderately to highly susceptible to landslides. Based on the impact significance criteria presented in Table 15.2.3-1, potential impacts to landslide potential from deployment or operation of the Proposed Action would, at the programmatic level, have *less than significant* impacts as it is likely the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be *potentially significant* if FirstNet's deployment locations were within areas in which landslides are highly prevalent. The highest potential for landslides in Texas is in the western portions of the Coastal Plain Province. To the extent practicable, FirstNet would avoid deployment in areas that are susceptible to landslide events. However, given that several of Texas' major cities, including Dallas, Fort Worth, Austin, and San Antonio, are in areas that are moderately to highly susceptible to landslide hazards, 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[150] and inundation of equipment. All of these activities could result in connectivity loss.

As discussed in Section 15.1.3.8, portions of Texas are vulnerable to land subsidence due to aquifer compaction and karst topography. Based on the impact significance criteria presented in Table 15.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would, at the programmatic level, have *less than significant* impacts; 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 or areas having aquifer compaction. 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, given that karst topography exists in many counties throughout the state, some amount of infrastructure may be subject to subsidence hazards, in which case BMPs and mitigation measures could help avoid or minimize 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 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 15.2.3-1, impacts to paleontological resources could be

[150] 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, 2015i)

potentially significant if FirstNet's buildout/deployment locations were to cause impacts to paleontological resources during construction activities. 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.. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Potential impacts to paleontological resources could be minimized by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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 15.2.3-1, 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* 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.

15.2.3.4. 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 geology, and other activities would have *no impacts*. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to geology under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. There would be *no impacts* to geologic resources 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* on geologic resources at the programmatic level because there would be no ground disturbance. 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. The section below addresses potential impacts associated with ground disturbing activities.
  - 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 are discussed below.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras would have *no impact* on soil resources because those activities would not require ground disturbance. The section below addresses potential impacts if ground disturbance activities occur in locations that are susceptible to specific geologic hazards.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have *no impact* on geologic resources.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: As stated above, if collocation does not require new utility poles or ground disturbance, there would be *no impacts* to geologic resources. However, replacementof utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in

locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: As stated above, although lighting up of dark fiber would have *no impacts* to geologic resources at the programmatic level, installation of new associated huts or equipment, if required, could result in ground disturbance during grading or excavation activities. Where equipment is installed in locations that are susceptible to specific geologic hazards, it is possible that equipment could be affected by that hazard.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: As stated above, disturbance associated with the installation of fiber optic cable in existing conduit have *no impacts* to geologic resources at the programmatic level. However, if fiber were installed in locations susceptible to landslides, earthquakes, or other geologic hazards, it is possible that the equipment could be affected by that hazard.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water is not expected to impact geologic resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Installation of Optical Transmission or Centralized Transmission Equipment: As stated above, if installation of equipment were to take place in existing facilities, there would be *no impact* to/from geologic resources. However, if installation of transmission equipment would occur in existing boxes or huts in areas that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Wireless Tower, Structure, or Building: As stated above, collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance and therefore would have *no impact* on geologic resources. However, if 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 wouldhave *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 there would be *no impacts* to geology 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 because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by to geologic hazards including minor seismic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be *less than significant* at the programmatic level as it is anticipated that deployment locations would avoid, as practicable and feasible, locations that are more likely to be affected by potential seismic activity, landslides, or land subsidence. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.3.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts at the programmatic level to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be *less than significant* at the programmatic level due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* to geologic resources at the programmatic level (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. Therefore, there would be *no impacts* to geologic resources (or from geologic hazards) at the programmatic level as a result of of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.3, Geology.

15.2.4. Water Resources

15.2.4.1. Introduction

This section describes potential impacts to water resources in Texas 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.

15.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 15.2.4-1. As described in Section 15.2, 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 15.2.4-1: 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 *potentially significant*, but with BMPs and mitigation measures is *less than significant* 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.		The impact is temporary, lasting no more than six months.	NA
Floodplain degradation[a]	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology; high likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant* 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.

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	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.		The impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant* 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.		The impact is temporary, lasting no more than six months.	NA
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant* at the programmatic level.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody.
	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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is *potentially significant*, but with BMPs and mitigation measures is *less than significant* 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.		Potential impact is temporary, not lasting more than six months.	NA

[a] Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See http://www.archives.gov/federal-register/codification/executive-order/11988.html and https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and).
NA = Not Applicable

15.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Generally, Texas' surface rivers and stream, lakes and reservoirs, and estuaries are in good condition, with less than 50 percent of those assessed being impaired. Some portions of the middle and upper Gulf Coast shoreline are impaired. Various sources affect Texas' waterbodies, causing impairments (USEPA, 2010a). Mercury and pathogens[151] are the two primary causes of impairment for waters along the Gulf Coast shoreline. Elevated levels of mercury in certain species of fish have resulted in a Saltwater Fish Consumption Advisory for many Texas Coastal Waters, particularly those near population concentrations (TPWD, 2015d). Additionally, organic enrichment, salinity (salt content), polychlorinated biphenyls, and pathogens are causes for impairment in assessed rivers and streams within Texas. Pathogens within the Sabine River Tidal area are caused by various sources, including combined sewer overflows, industrial point source discharge, and municipal runoff from high-density areas (TCEQ, 2014a).

Development activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a USEPA National Pollutant Discharge Elimination System (NPDES) Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a storm water pollution prevention plan (SWPPP) would need to be prepared containing BMPs 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.

[151] Pathogen: a bacterium, virus, or other microorganism that can cause disease (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, and Safe Drinking Water Act), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 15.2.4-1, water quality impacts would likely be *less than significant* at the programmatic level, and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching[152] 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 Texas 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 the average thickness of most Texas aquifers, there is potential for groundwater contamination within a watershed or multiple watersheds. 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 15.2.4-1, at the programmatic level, there would likely be *less than significant* impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Furthermore, BMPs and mitigation measures would be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood

[152] 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).

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 15.2.4-1, 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, 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, [153] or occur only during an emergency.

Examples of activities that would have *less than significant* impacts include:

- Construction of any structure in the 500-year floodplain but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that include pervious surfaces such as gravel parking lots.
- Land uses that do not change the flow of water or drainage patterns.
- Limited clearing or grading activities.

Implementation of BMPs and mitigation measures could reduce the risk of additional impacts to floodplain degradation (see Chapter 16).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could changes 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 storm water drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in storm water 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); storm water increases; or altered flow patterns.

According to the significance criteria in Table 15.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered *less than significant* at the programmatic level.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited storm water runoff.
- Where storm water is contained on site and does not flow to or impact surface waterbodies off-site on other properties.

[153] 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, 2016b)

- Activities designed so that the amount of storm water generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to drainage patterns would be *less than significant* at the programmatic level. BMPs and mitigation measures could be implemented to further reduce any impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 15.2.4-1. Projects that include minor consumptive use of surface water with *less than significant* impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have *less than significant* impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have *less than significant* impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of storm water previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts to flow alteration would be *less than significant* at the programmatic level. BMPs, mitigation measures, and avoidance would further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 15.1.4.7, approximately 59 percent of water used in Texas is supplied by groundwater sources. Generally, the water quality of Texas' aquifers is suitable for drinking and daily water needs. Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes.

(George, Mace, & Petrossian, 2011). 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 likely to cause *less than significant* impacts to water quality at the programmatic level due to the expected small volume of these materials. Activities that may cause changes in groundwater or aquifer characteristics include:

- Excavation or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Bulk storage of petroleum or chemical products.
- Use of pesticides, herbicides, or insecticides during or after construction of a commercial, industrial, or recreational use.

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. It is likely that areas that utilize groundwater for potable water purposes would be avoided. According to Table 15.2.4-1, *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.

15.2.4.4. 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, 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* on water resources because there would be no ground disturbance.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance, 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.

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.
- 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 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.

15.2.4.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to water resources if those activities occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving; however, these activities would be isolated and short term, and would likely return to baseline conditions once revegetation was complete. Additionally, project activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites and from fuels leaking into surface or groundwater. However, spills from vehicles or machinery used during deployment tend to be associated with re-fueling operations, and as such, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have *less than significant* impacts at the programmatic level. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be *no impacts* at the programmatic level to water resources associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods 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 at the programmatic level to water quality, due to the small-scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to water resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.4, Water Resources.

15.2.5. Wetlands

15.2.5.1. Introduction

This section describes potential impacts to wetlands in Texas 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..

15.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 15.2.5-1. As described in Section 15.2, Environmental Consequences, the categories of impacts are defined at the programmatic level as *potentially significant, less than significant with mitigation measures incorporated, less than significant,* or *no impact*. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

Table 15.2.5-1: Impact Significance Rating Criteria for Wetlands at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude[a] or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is *potentially significant*, but with mitigation is *less than significant* 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 high quality wetlands.	Effect that is *potentially significant*, but with mitigation is *less than significant* 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 high quality 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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration	NA
Indirect Effects: [b] Change in Function(s)[c] Change in Wetland Type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	USGS watershed level, and/or within multiple watersheds.		USGS watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent change in function or type that is not restored within two growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[a] "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories (USACE 2014). Category 1 are the highest quality, highest functioning wetlands.
[b] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.
[c] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.
NA = Not Applicable

15.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be *less than significant* 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 4.96 million acres of wetlands throughout Texas (USFWS, 2015a). In Texas, palustrine (freshwater) wetlands found on river and lake floodplains across the state (mostly on the eastern half of the state), are the main type of wetlands, as shown in Figure 15.1.5-1, Figure 15.1.5-2:, and Figure 15.1.5-3.

Based on the impact significance criteria presented in Table 15.2.5-1, 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 local regulations.

In Texas, as discussed in Section 15.1.5.4, Wetlands, as part of Texas' CWA Section 401 Water Quality Certification process, TCEQ requires additional review for types of rare or ecologically significant wetlands, including pitcher plant bogs; swamps dominated by bald cypress and tupelo gum tree species; Caddo Lake (designated as a Ramsar Wetland of International Importance);[154] mangrove marshes; coastal dune swales; and other significant wetlands such as those part of the

[154] "The Convention on Wetlands of International Importance, known as the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use (defined as the conservation and sustainable use of wetlands and their resources, for the benefit of humankind) of wetlands and their resources." (USFWS, 2015bd)

Gulf Ecological Management Site (GEMS) Program. If any of the proposed deployment activities were to occur in these high quality wetlands, *potentially significant* impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work to avoid *potentially significant* impacts to wetlands. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as storm water discharges or water withdrawals that alter the functions of the wetlands.

Construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause *potentially significant* impacts. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds could be *potentially significant*. Based on the impact significance criteria presented in Table 15.2.5-1, 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 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 Texas include:

- *Vegetation Clearing:* removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance:* Increased amounts of storm water runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.

- *Direct Hydrologic Changes (flooding or draining):* Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- *Direct Soil Changes:* Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter, such as the acidic conditions of Atlantic white cedar swamps and alkaline conditions of sea-level fens (which are high quality wetlands in Texas).
- *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:[155] Change in Function(s)[156] 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 Texas 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.

[155] 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.
[156] 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.

- *Bank Stabilization:* By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- *Water Quality:* Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism 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 15.2.5-1, 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*. Since the wetlands comprise less than five percent of its total land area in Texas, deployment activities could have *less than significant* indirect impacts on wetlands in the state. In areas of the state with high quality wetlands, there could be *potentially significant* impacts at the project level that may require site-specific analysis depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. If avoidance were not possible, potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.5.4. 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* at the programmatic level to wetlands under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be *no impacts* at the programmatic level to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launched for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would not impact wetlands, it is anticipated that this activity would have *no impact* on wetlands.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground

disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. 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 impact assessments could 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 hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if the additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Deployable Technologies
    - Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of

technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, or blimps piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be *less than significant* at the programmatic level due to the small about 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. It is anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections, and assuming that all federal, state, and local requirements associated with refueling and vehicle maintenance are followed. If heavy equipment is used as part of routine maintenance or inspections off of established access roads or corridors, or if routine maintenance and application of herbicides is used to control vegetation, potential wetland impacts could be *less than significant* at the programmatic level as explained above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to further avoid or minimize potential impacts.

15.2.5.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this alternative could be as described below.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant* impacts at the programmatic level to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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.

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *no impacts* at the programmatic level to wetland resources associated with routine inspections of the Deployable Technologies Alternative, assuming the use of access roads and compliance with refueling and vehicle maintenance requirements, and *less than significant* potential impacts at the programmatic level associated with maintenance activities if heavy equipment is used as part of routine maintenance, if or inspections occur off of established access roads or corridors, or if routine maintenance and application of herbicides is used to control vegetation. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to wetlands at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.5, Wetlands.

15.2.6. Biological Resources

15.2.6.1. Introduction

This chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Texas associated with deployment and operation of the Proposed Action and its alternatives. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.6.2. 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 15.2.6-1. As described in Section 15.2, 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 terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 15.2.6.3, 15.2.6.4, and 15.6.2.5, respectively, are presented as a range of possible impacts. Refer to Section 15.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Texas.

Table 15.2.6-1: 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 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 *potentially significant*, but with mitigation is *less than significant*.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed Texas for at least one species. Anthropogenic[a] disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with 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 *potentially significant*, but with mitigation is *less than significant*.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Texas 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	Impact Level: Less than Significant with Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: 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 *potentially significant*, but with mitigation is *less than significant*.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Texas 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 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 *potentially significant*, but with mitigation is *less than significant*.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed Texas 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 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 *potentially significant*, but with mitigation is *less than significant*.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Texas for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning, or anthropogenic disturbances, that lead to 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 Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Texas.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

[a] Anthropogenic: "Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities" (USEPA, 2016c).
NA = Not Applicable

15.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Texas 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 15.2.6-1, 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, these 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

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. In Texas, about 57 percent of the total land cover is rangeland and about 25 percent of the land cover is unfragmented forest. In addition, about 24 percent of the state is pastureland and cropland (NRCS, 2010).

Comments received on other regional Draft PEIS documents for the Proposed Action expressed concerns related to the potential impacts to vegetation from RF emissions. Some studies have indicated the potential for *adverse effects* to vegetation from RF emissions. As explained in Section 2.4, Radio Frequency Emissions, as well as Section 3.2.6.4, Wildlife, additional, targeted research needs to be conducted to more fully document the nature and effects of RF exposure, including the potential impacts to vegetation.

Construction of new infrastructure and long-term facility maintenance would result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. In general, these impacts are expected to be *less than significant* at the programmatic level due to the short-term, localized nature of the deployment activities. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be recommended and consultation with the appropriate resource agenices, if required, could be undertaken to minimize or avoid 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.

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 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 can have a dramatic effect on natural resources and biodiversity. The Texas Department of Agriculture maintains a list of regulated noxious weeds.

As described in Section 15.1.6.4, 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, these impacts are expected to be *less than significant* at the programmatic level due to the small scale and localized nature of likely FirstNet activities. BMPs and mitigation measures could help to minimize or avoid the potential for introducing invasive plant 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range impacts, from *no impacts* to *less than significant* impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology,[157] and the nature as well as the extent of the habitats affected. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No Impacts at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to terrestrial vegetation under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch

[157] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have *no impact* on terrestrial vegetation.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to terrestrial vegetation as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; indirect injury/mortality; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to terrestrial vegetation include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to terrestrial vegetation. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
    - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help 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 and inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help 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, the vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. Despite the variability, these impacts are expected to be *less than significant* at the programmatic level due to the small-scale and limited geographic scope of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be *no impacts* at the programmatic level to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. Site maintenance, including mowing or herbicides, may result in *less than significant* effects at the programmatic level due to the small-scale of expected activities. These potential impacts could result from accidental spills from maintenance equipment or release of herbicides and because these areas would not be allowed to revert to a more natural state. If usage of heavy equipment or land clearing activities occurs off established roads or corridors as part of routine maintenance or inspections, direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species could occur to terrestrial vegetation; however, impacts are expected to be *less than significant* at the programmatic level due to the small-scale of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As described above, 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, it is anticipated that there would be *less than significant* impacts at the programmatic level to terrestrial vegetation associated with routine operations and maintenance due to the relatively small-scale of likely FirstNet project sites. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to terrestrial vegetation at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.6.3, Terrestrial Vegetation.

15.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and invertebrates occurring in Texas and Texas' 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 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 15.2.6-1, *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, as discussed below, except for birds which would be *less than significant with BMPs and mitigation measures incorporated*. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed; therefore, impacts are generally expected to be *less than significant* at the programmatic level, as discussed further below. 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.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Texas. 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.

For example, 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 associated with the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Marine Mammals

Marine mammals swimming or hauled out on land are sensitive to boats, aircraft, and human presence. Noises, smells, sounds, and sights may elicit a flight reaction. Trampling deaths associated with haulout disturbance are known source of mortality for seals but are not anticipated from likely FirstNet deployment activities.

Entanglements from marine debris as well as ingestion of marine debris could result in injury or death to marine mammals. Marine debris is any manmade object discarded, disposed of, or abandoned that enters the marine environment. Entanglements from marine debris are not anticipated from FirstNet activities.

Many of the whale species known to occur offshore of Texas are also protected under the ESA. Environmental consequences pertaining to these whales are discussed in Section 15.2.6.6, 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 “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, 2012) (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 in Texas could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for nesting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (NAS, 2015d).

Direct mortality and injury to birds of Texas are not likely to be widespread or affect populations of species as a whole due to the small size of likely FirstNet actions, however, DOI comments dated October 11, 2016[158] state that communication towers are "currently estimated to kill between four and five million birds per year", although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights. Additionally, on Jan. 6, 2017 the FCC issued a notice titled Opportunities to Reduce Bird Collisions with Communications Towers While Reducing Tower Lighting Costs) (FCC, 2017) . See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable or feasible, to further avoid or minimize potential impacts to birds from tower lighting. Site-specific analysis and/or consultation with FWS may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work.. If siting considerations and BMPs and mitigation measures are implemented (Chapter 16), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures, as defined through consultation with USFWS.

Reptiles and Amphibians

In Texas, some reptiles and amphibians are widely distributed throughout the state, while some species have more limited ranges. 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.

[158] See Appendix F, Draft PEIS Public Comments, for the full text of the Department of Interior comments.

Four species of marine turtles – all listed as threatened or endangered under the ESA – occur in Texas' offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 15.2.6.6, 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 Texas 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 15.2.6.3, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action would cause exclusion effects only in very special circumstances, as in most cases an animal could fly, swim, or walk to a nearby area that would provide refuge.

In general, potential effects of vegetation and habitat loss, alteration, or fragmentation are expected to be *less than significant* at the programmatic level because of the small-scale nature and limited geographic scope of expected deployment activities. These potential impacts are described for Texas' wildlife species below. 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.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Texas 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

The West Indian manatee inhabits Texas' tidal waters, easily moving from fresh to estuarine to marine environments (USFWS, 2015e). Manatees often use secluded canals, creeks, embayments, and lagoons, particularly near the mouths of coastal rivers and sloughs, for feeding, resting, mating, and calving (USFWS, 2001a). Manatees could be temporarily excluded from a resource due to the presence of humans, noise, or vessel traffic during deployment activities. Effects on manatees from exclusion from resources would be low magnitude and temporary in duration.

Loss of habitat or exclusions from these areas for manatees would be avoided or minimized by BMPs and mitigation measures (see Chapter 16), as appropriate. Environmental consequences pertaining to the endangered whales protected under the ESA are discussed in Section 15.2.6.6, 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 TPWD provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The remove and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitats.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the State as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). DOI comments dated October 11, 2016, state that communication towers are “currently estimated to kill between four and five million birds per year”, although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts. Of particular concern is avian mortality due to collisions with towers at night, when birds can be attracted to tower obstruction lights. Research has shown that birds are attracted to steady, non-flashing red lights and are much less attracted to flashing lights, which can reduce migratory bird collisions by as much as 70%. The FAA has issued requirements to eliminate steady-burning flashing obstruction lights and use only flashing obstruction lights (FAA, 2016c) (FCC, 2017). See Chapter 16, BMPs and Mitigation Measures, for BMPs and mitigation measures that FirstNet and/or their partners would require, as practicable and feasible, to further avoid or minimize potential impacts to birds from tower lighting.

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stop overs (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Texas' amphibians and reptiles include wetlands and the surrounding upland forest, as well as coastal areas. Impacts are expected to be *less than significant* at the programmatic level given the short-term nature and limited geographic scope of individual activities. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 16) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 15.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Texas' amphibian and reptile populations, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.[159]

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 *less than significant* impacts to invertebrates are expected at the programmatic level. Impacts to sensitive invertebrate species are discussed below in Section 15.2.6.6, Threatened and Endangered Species.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment. Overall, impacts are expected to remain *less than significant* at the programmatic level (except for birds and bats due to potential exposure to RF emissions, see below) due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could further help to avoid or minimize the potential impacts. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would be unlikely to occur, therefore impacts are expected to be *less than significant* at the programmatic level, except for bats (see below).

[159] See Section 7.2.5, 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 emissions compared with control sites, and attributed this behavior to the increased risk of overheating and echolocation interference caused by electromagnetic field exposure (Nicholls & Racey, 2009). As stated below, experts emphasize that targeted field research needs to be conducted to more fully document the nature and extent of effects of RF exposure on bats and other wildlife, and the implications of those effects on populations over the long term (Manville, Recommendations for Additional Research and Funding to Assess Impacts of Non-Ionizing Radiation to Birds and Other Wildlife, 2015) (Manville, 2016a) (Appendix G). FirstNet recognizes that RF exposure has the potential to adversely impact bats, particularly bats that communally roost or breed and nurture young in areas with RF exposure, and concurs with the need for further research. As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from known communal bat use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures) to help reduce bird mortalities associated with both RF emissions and tower collision. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

Marine Mammals

Repeated disturbance (e.g., from vessel traffic) could cause stress to individuals resulting in lower fitness and productivity. Given that the majority of FirstNet deployment activities are not expected to be located onshore or in the oceanic environment, *less than significant* impacts to *no impacts* would be anticipated for marine mammals.

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. However, the majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would be unlikely to occur.

Research indicates that RF exposure may adversely affect birds. A comment letter on the Draft Programmatic Environmental Impact Statement for the West region, presented by Dr. Albert Manville, former USFWS agency lead on avian-structural impacts, summarizes the state of scientific knowledge of the potential effects of RF exposure on wildlife, particularly migratory birds; the comment letter is presented in its entirety in Appendix G. RF exposure may result in adverse impacts on wildlife, although a distinct causal relationship between RF exposure and responses in wild animal populations has not been established. Further, important scientific questions regarding the mechanisms of impact, the exposure levels that trigger *adverse effects*, and the importance of confounding factors in the manifestation of effects, among other questions, remain unanswered (Manville, 2016b) (Appendix G).

Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian and mammalian subjects, including embryonic mortality in bird eggs, genetic abnormalities, cellular defects, tumor growth, and reproductive and other behavioral changes in adult birds and rodents (DiCarlo, White, Guo, & Litovitz, 2002) (Wyde, 2016) (Levitt & Lai, 2010) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008).

Few studies of the effects of RF exposure on wild animal populations have been conducted due to the difficulty of performing controlled studies on wild subjects. Those that have been conducted are observational in nature (i.e., documenting of reproductive success and behavior in birds near RF-emitting facilities). These studies lack controls on exposure levels or other potentially confounding factors. Nevertheless, findings from these studies indicate reduced survivorship at all life stages; physiological problems related to locomotion and foraging success; and behavioral changes that resulted in delayed or unsuccessful mating in several species of nesting birds (Balmori, 2005) (Balmori, A., 2009) (Balmori, A; Halberg, O;, 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,[160] 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.

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

[160] 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.

invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be *less than significant* at the programmatic level.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the small-scale and localized nature of expected activities, which would be unlikely to result in long-term avoidance. Potential effects to migration patterns of Texas' fauna are described below. 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. See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

<u>Terrestrial Mammals</u>

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.[161]

Any clearance, drilling, and construction activities needed for network deployment, including noise and vibration associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

<u>Marine Mammals</u>

Noise and vibration associated with the installation of cables in the near/offshore waters of coastal Texas could impact 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 B sound exposure thresholds.[162] 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 vibration and noise-generating activities would be of short duration and are not likely to result in long-term avoidance. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

[161] A location chosen by an animal for hibernation.

[162] Level A: 190 dB re 1μPa (rms) for seals and 180 dB re 1μPa (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 1μPa (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).

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, as a group, shorebirds migrating through Texas undertake some of the longest-distance migrations of all animals. Texas has 25 IBAs throughout the state serving as important stopover, breeding, and wintering areas for migratory birds (NAS, 2015d). Many migratory routes are passed from one generation to the next. Additionally, there is some evidence in the scientific literature that RF emissions could affect bird migration. Engels *et al.* (*2014*) documented that migratory birds are unable to use their magnetic compass in the presence of urban electromagnetic noise, which can disrupt migration or send birds off course, potentially resulting in reduced survivorship. It is unlikely that the limited amount of infrastructure, the amount of RF emissions generated by Project infrastructure, and the temporary nature of the deployment activities would result in impacts to large populations of migratory birds, but more likely that individual birds could be impacted. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate in Texas. For example, the Houston toad inhabits woodland savannahs, but migrates to areas with flowing water to breed (TPWD, 2015v). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien, 1990) (Calhoun & DeMaynadier, 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but 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 Texas' invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Overall, potential impacts are anticipated to be *less than significant* at the programmatic level due to the short-term and limited nature of expected activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of 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 calving grounds for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Texas. 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

Marine mammals return to their calving grounds annually for reproductive success. Although unlikely, the displacement of female seals from preferred pupping habitats, may reduce fitness and survival of pups potentially affecting overall productivity. However, activities are likely to be small-scale in nature and contribute only minimally to minor, short-term displacement, and BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Disturbance to hauled out seals from activities associated with the Proposed Action could result in the abandonment, or death of offspring, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual, noise, and vibration) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). Research conducted to date under controlled laboratory conditions has identified a wide range of physiological and behavioral changes in avian subjects, including embryonic mortality in bird eggs and reproductive changes in adult birds (DiCarlo, White, Guo, & Litovitz, 2002) (Wyde, 2016) (Levitt & Lai, 2010) (Grigor'ev, 2003) (Panagopoulos & Margaritis, 2008). Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in embryonic mortality (Manville, 2007) (DiCarlo, White, Guo, & Litovitz, 2002). These studies suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) (see Section 2.4.2, RF Emissions and Humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, it is unclear how this exposure would affect organisms in the wild.

As such, and as a precaution, FirstNet would implement BMPs and mitigation measures that focus on siting towers away from high bird use areas to the extent practicable or feasible (described in Chapter 16, BMPs and Mitigation Measures). See Section 2.4, Radio Frequency Emissions, for additional information on potential RF exposure impacts.

The majority of FirstNet deployment or operation activities are likely to be small-scale. Applicable BMPs and mitigation measures, as defined through consultation with USFWS for MBTA or BGEPA, if required, could help to avoid or minimize any potential impacts. Environmental consequences pertaining to federally listed species will be discussed in Section 15.2.6.6, Threatened and Endangered Species and Species of Concern.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the hawksbill sea turtle travels from its habitat in shallow coastal waters to remote nesting sites on beaches in the Gulf of Mexico and Caribbean (USFWS, 2015f). Ground disturbing activities near potential nesting sites could cause potential impacts to hawksbill sea turtles.

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 and mitigation measures could help to avoid or minimize the potential impacts.

Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature and not use pesticides or substantially reduce habitat, which could impact the reproductive success of pollinators or other invertebrates. Therefore; no reproductive effects to invertebrates are expected as a result of the Proposed Action.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources.

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites; although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers. Therefore, potential impacts are expected to be *less than significant* at the programmatic level.

Potential invasive species effects to Texas' wildlife are described below.

Terrestrial Mammals

In Texas, feral pigs adversely impact native wildlife, including turkey and quail. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and can carry/transmit disease to livestock and humans (TPWD, 2015ae).

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 plant species during implementation of the Proposed Action as well as minimize effects to terrestrial mammals as a result of the introduction of invasive species.

Marine Mammals

Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would be limited. 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 marine mammals as a result of the introduction of invasive species.

Birds

FirstNet deployment activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. Invasive bird species are not expected to be introduced at project sites as part of the deployment activities from machinery or construction workers, therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures (see Chapter 16) would help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action as well as minimize effects to birds as a result of the introduction of invasive species.

Reptiles and Amphibians

Texas has not adopted regulations that prohibit or regulate the possession, transport, importation, sale, or purchase of terrestrial wildlife species, including reptiles and amphibians. However, two non-native (invasive) retiles may occur in the state: the brown tree snake and Mediterranean house gecko (Texas Invasives, 2016)). Non-native reptiles and amphibians tend to be highly adaptable and can threaten native wildlife by competing with them for food sources and also spread disease. 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 terrestrial reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers during deployment operations. 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 plant species during implementation of the Proposed Action as well as minimize effects to reptiles and amphibians as a result of the introduction of invasive species.

Invertebrates

Invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a large threat to forest and agricultural resources in Texas (USDOT, 2015c). 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) could help to avoid or minimize the potential for introducing invasive terrestrial invertebrate species during implementation of the Proposed Action. BMPs and mitigation measures would also help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action as well as minimize effects to invertebrates as a result of the introduction of invasive species.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from *no impacts* to *less than significant* impact 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No Impacts at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to wildlife resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise and vibration generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, 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.

<u>Activities with the Potential to Have Impacts at the Programmatic Level</u>

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment 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 vibration, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
   - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of 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 and inland bodies of water and construction of landings and/or facilities on the shores or banks of waterbodies that accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 15.2.4, 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. 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 wildlife. However, if new power units, replacement towers, or structural hardening were required, impacts would be similar to new wireless construction. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise and vibration disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions. Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise and vibration. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be *less than significant* at the programmatic level given the small-scale of likely individual FirstNet projects, with the exception of impacts to birds and bats, which are expected to be *less than significant with BMPs and mitigation measures incorporated.* Some some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and are therefore expected to remain *less than significant* at the programmatic level. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

At the programmatic level, it is anticipated that there would be *less than significant* impacts to wildlife resources associated with routine inspections of the Preferred Alternative. Site maintenance, including mowing or limited application of herbicides, may result in *less than significant* impacts at the programmatic level to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. Potential spills of these materials would be expected to be in small quantities.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. In particular, collisions with new cell towers that may be installed as part of the Preferred Alternative could increase avian mortality. As stated above, these impacts would likely be limited to individual wildlife species. DOI comments dated October 11, 2016 stated that communication towers are "currently estimated to kill between four and five million birds per year", although collisions with towers have the potential to impact a large number of birds unless BMPs and mitigation measures are incorporated, tower collisions are unlikely to cause population-level impacts.

Wildlife resources could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individuals and unlikely to cause population-level impacts, and therefore would likely be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this Alternative could be as described below.

<u>Deployment Impacts</u>

As described above, at the programmatic level implementation of deployable technologies could result in *less than significant* impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* 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.

<u>Operational Impacts</u>

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be *less than significant* impacts at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. Proposed FirstNet actions at some individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to wildlife resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.6.4, Terrestrial Wildlife.

15.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Texas and Texas' near offshore environment are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012e).

Based on the impact significance criteria presented in Table 15.2.6-1, *less than significant* impacts would be anticipated at the programmatic level given that the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (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, potential impacts are expected to be *less than significant* at the programmatic level. 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 15.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are not anticipated, and therefore impacts are expected to be *less than significant* at the programmatic level. BMPs and mitigation measures could help to further avoid or minimize the 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. Impacts are expected to be *less than significant* at the programmatic level due to the limited extent and temporary nature of the deployment. 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, 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 BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No impacts at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no impacts* to fisheries and aquatic habitats under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibration, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects to fisheries and aquatic 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* on fisheries and aquatic habitats because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance .
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch

vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have *no impact* on the aquatic environment.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the 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 (some fish). Disturbance, including noise and vibration, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of 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, 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 resrouces. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
    Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. 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 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 impact aquatic habitats. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated, 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 may include accidental spills from maintenance equipment or pesticide runoff near fish habitat are anticipated to result in *less than significant* impacts at the programmatic level 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.

<u>Deployment Impacts</u>

As explained above, at the programmatic level, implementation of deployable technologies could result in *less than significant* impacts from habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain *less than significant* 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.

<u>Operational Impacts</u>

Operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, the impacts could vary greatly among species and geographic region. Nonetheless, it is anticipated that there would be *less than significant* impacts at the programmatic level to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no impacts* to fisheries and aquatic habitats at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.6.5, Fisheries and Aquatic Habitats.

15.2.6.6. Threatened and Endangered Species

This section describes potential impacts to threatened and endangered species in Texas and Texas' on shore 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 15.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as *may affect*, *likely to adversely affect*; *may affect, not likely to adversely affect*; and *no effect*.

These impact categories are comparable to those defined in the *Endangered Species Consultation Handbook* and are described in general terms below (FWS, 1998):

- *No effect* means that no listed resources would be exposed to the action and its environmental consequences.
- *May affect, not likely to adversely affect* means that all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any *adverse effects* to the species or habitat. Insignificant effects relate to the size of the impact and include those effects that are undetectable, not measurable, or cannot be evaluated. Discountable effects are those extremely unlikely to occur.
- *May affect, likely to adversely affect* means that listed resources are likely to be exposed to the action or its environmental consequences and would respond in a negative manner to the exposure.

Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 15.2.6-2: 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 *likely to adversely affect* category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect 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 *likely to adversely affect* threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

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 15.2.6-2, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has more than a negligible potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, *may affect but is not 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 Texas 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.

<u>Terrestrial Mammals</u>

Three endangered terrestrial mammal species are federally listed and known to occur in the state of Texas; they are the Gulf Coast jaguarondi, Mexican long-nosed bat, and ocelot. Direct mortality to the federally listed Gulf Coast jaguarondi or ocelot could occur from vehicle strikes, as these species are occasionally found along transportation corridors. Entanglement in fences or other barriers could also be a source of mortality or injury to this species. Impacts would likely be isolated, individual events and therefore *may affect*, *but are not likely to adversely affect*, listed species.

Direct mortality or injury to the federally listed Mexican long-nosed bat could occur if vegetation clearing activities occurred at foraging sites while bats were present or if caves were flooded or blocked off while bats were present (NMDGF, 2014). While projects would not likely directly affect winter hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could affect these species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

<u>Marine Mammals</u>

One endangered marine species is federally listed and known to occur in the state of the Texas, the West Indian manatee. Entanglements from marine debris as well as ingestion of marine debris are unlikely due to the limited nature of expected FirstNet activities in in the marine environment. Therefore potential impacts *may affect*, *but are not likely to adversely affect*, manatees. 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

Nine endangered and five threatened bird species are federally listed and known to occur in the state of Texas, as summarized in Table 15.1.6-6. Depending on the project types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts *may affect*, *but are not likely to adversely affect*, listed species as FirstNet would attempt to avoid deployment activities in areas where they are known to nest. If proposed project sites are unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Nine endangered and two threatened fish species are federally listed and known to occur in Texas; they are the Arkansas River shiner, Big Bend gambusia, Clear Creek gambusia, Comanche Springs pupfish, Devils River minnow, fountain darter, Leon Springs pupfish, Pecos gambusia, San Marcos gambusia, sharpnose shiner, and smalleye shiner. Direct mortality or injury to these species could occur from vessel/boat strikes or entanglements resulting from the Proposed Action, but are unlikely as the majority of FirstNet deployment projects would not occur in the aquatic environment. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Four endangered and four threatened amphibian species are federally listed and known to occur in the state of Texas; they are the Austin blind salamander, Barton Springs salamander, Georgetown salamander, Houston toad, Jollyville Plateau salamander, Salado salamander, San Marcos Salamander, and Texas blind salamander. Direct mortality to reptiles could occur in construction zones either by excavation activities or by vehicle strikes. Impacts would likely be isolated, individual events, and FirstNet would attempt, as practicable and feasible, to avoid areas where these species may occur. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species.

Five federally listed sea turtles, the Hawksbill sea turtle; the Leatherback sea turtle; the loggerhead sea turtle; the green sea turtle and the Kemp's Ridley sea turtle, are also known to occur in the coastal area and offshore environment of Texas. None of these turtles nest in the Texas area. Direct mortality or injury could occur from watercraft and vessels strikes, but are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. Therefore potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Twenty-seven endangered invertebrate species are federally listed and known to occur in the state of Texas, as summarized in Table 15.1.6-9. Direct mortality or injury could occur to terrestrial invertebrate species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid, as practicable and feasible, areas where these species may occur.

The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to aquatic invertebrate species 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 *unlikely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Twenty-three endangered and seven threatened plant species are federally listed and known to occur in Texas as summarized in Table 15.1.6-10. 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. In general, distribution of these species is limited throughout the state. FirstNet would attempt to avoid, as practicable and feasible, areas where these species may occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species 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 Texas are described below.

Terrestrial Mammals

Noise, vibration, light, and other human disturbances associated with the Proposed Action could affect federally listed terrestrial mammals within or in the vicinity of Project activities. For example, activities that may inhibit access or cause breeding location abandonment by the Gulf Coast jaguarondi. Impacts would be directly related to the frequency, intensity, and duration of these activities; however, they are anticipated to be small-scale and localized. FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Marine Mammals

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). The majority of FirstNet activities would not occur in the aquatic environment; potential impacts *may affect*, *but are not likely to adversely affect*, the listed species. Therefore, no long-term reproductive effects to the manatee are expected as a result of the Proposed Action.

Birds

Noise, vibration, light, or human disturbance within nesting areas could cause federally listed birds, such as the piping plover, to relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. The majority of FirstNet deployment activities would not occur on beaches; therefore, impacts to these bird species are not anticipated. FirstNet would attempt to avoid, as practicable and feasible, areas where other federally listed bird species, such as the red knot, are known to occur. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress to federally listed species, such as the Houston toad, resulting in lower productivity. Land clearing activities, noise, vibration, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

The five federally listed sea turtles found in the offshore areas of Texas are migrants. Consequently, similar to federally listed marine mammals, no long-term reproductive effects to federally listed sea turtles are expected as a result of the Proposed Action.

Fish

Deployment activities in the upstream portions of the Texas River watershed resulting in increased disturbance (e.g., humans, noise, vibration), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 15.2.4, Water Resources, for a discussion of potential impacts to water resources). Impacts to reproduction for the endangered fish species are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes resulting from ground disturbing activities could cause stress resulting in lower productivity for the federally listed invertebrates, such as the Coffin Cave mold beetle, known to occur in Texas. Potential impacts to federally listed invertebrate species *may affect*, *but are not likely to adversely affect*, those species, as FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could occur from ground-disturbing activities to listed plant species, such as the star cactus, as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially adverse. Potential effects to federally listed terrestrial mammals, marine mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Texas 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 ocelot, 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 Texas. Further, increased human disturbance, noise, vibration, 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, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

<u>Marine Mammals</u>

Noise and vibration associated with the installation of cables in the near/offshore waters of coastal Texas could impact 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 B sound exposure thresholds. Marine mammals such as the manatee have the capacity to divert from sound sources during migration. The majority of FirstNet projects would not occur in the aquatic environment; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, the manatee. 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.

<u>Birds</u>

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, the yellow-billed cuckoo migrates thousands of miles from their breeding grounds in the western United States to their wintering sites in South America. Disturbance in stopover, foraging, or breeding areas (visual, noise, or vibration) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in effects to federally listed birds. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of federally listed 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, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Fish

Changes in water quality as a result of ground disturbing activities could impact food sources for federally listed species, such as the shortnose sturgeon. Further, increased human disturbance, noise, vibration, and vessel traffic could cause stress to shortnose sturgeon causing them to abandon spawning locations or alter migration patterns. Behavioral changes to these listed species 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 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 snails resulting in lower productivity. Disturbances to food sources utilized by federally listed terrestrial species, such as the Tooth Cave spider, could impact foraging behavior. FirstNet would attempt to avoid areas, as practicable and feasible, where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be *potentially significant*. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to *potentially significant adverse effects*, such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed birds, reptiles and amphibians, fish, invertebrates, and plants with designated critical habitat in Texas are described below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Texas. 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

No designated critical habitat occurs in Texas for the West Indian manatee. Therefore, *no effect* to this species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

Two of the federally listed bird species in Texas have federally designated critical habitat. Critical habitat for the piping plover was designated in Cameron, Willacy, Kennedy, Kleberg, Nueces, Aransas, Calhoun, Matagorda, and Brazoria Counties, Texas. Critical habitat for the whooping crane was designated in the Aransas National Wildlife Region of Texas. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other 14 federally listed bird species in Texas; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Reptiles and Amphibians

Four of the eight federally listed amphibians in Texas have federally designated critical habitat. Critical habitat for the Austin blind salamander was designated in the City of Austin in Travis County. Critical habitat for the Houston toad was designated in Burleson County. Critical habitat for the Jollyville Plateau salamander was designated in Travis County. Critical habitat for the San Marcos salamander was designated in Hays County. Land clearing, excavation activities, and other ground disturbing activities in this region of Texas could lead to habitat loss or degradation, depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other four federally listed amphibian species nor the federally listed reptile species in Texas; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Fish

Six of the federally listed fish species in Texas have federally designated critical habitat. Critical habitat for Devils River minnow was designated in Val Verde and Kinney Counties. Critical habitat for the fountain darter was designated in Hays County. Critical habitat for the Leon Springs pupfish was designated in Leon Creek in Pecos County. Critical habitat for the sharpnose shiner and smalleye shiner was designated in Baylor, Crosby, Fisher, Garza, Haskell, Kent, King, Knox, Stonewall, Throckmorton, and Young Counties, in the upper Brazos River basin of Texas. Critical habitat for the San Marcos gambusia was designated along San Marcos River in Hays County. 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, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other five federally listed fish species in Texas; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Invertebrates

Of the 27 federally listed invertebrate species in Texas, 19 of them have federally designated critical habitat, as summarized in Table 15.1.6-9. Land clearing, excavation activities, and other ground disturbing activities in these regions of Texas could lead to habitat loss or degradation, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other eight federally listed invertebrate species in Texas; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Plants

Five of the federally listed plant species in Texas have federally designated critical habitat. Critical habitat for the Neches River rose-mallow was designated in Cherokee, Houston, Harrison, Nacogdoches, and Trinity Counties. Critical habitat for the Pecos sunflower was designated in Pecos County. Critical habitat for the Texas golden gladecress was designated in Sabine and San Augustine Counties. Critical habitat for the Texas wild-rice was designated in Hays County. Critical habitat for the Zapata bladderpod was designated in Starr County.

Land clearing, excavation activities, and other ground disturbing activities in these regions of Texas could lead to habitat loss or degradation, which could affect these plants depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur; therefore, potential impacts *may affect*, *but are not likely to adversely affect*, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed plant species in Texas; therefore, *no effect* to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no effects* to *may affect*, but not likely to adversely effect, depending on the deployment scenario or site-specific conditions. Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. 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.

<u>Activities Likely to Have No Effect at the Programmatic Level</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have *no effect* to threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise and vibration, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened 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.

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 impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise and vibration, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.

- New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to 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 banks of waterbodies that accept submarine cables could potentially impact threatened and endangered species and their habitat, particularly aquatic species (see Section 15.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. If activities occurred during critical time periods, reproductive effects and behavioral changes could occur.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be *no impacts* to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an

existing tower; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. FirstNet would attempt to avoid areas, as practicable and feasible, where these species are known to occur; therefore, potential impacts *may affect*, but are not likely adversely affect protected 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.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. For potential impacts to birds and bats from RF emissions, please see section 15.2.6.4. Wildlife.

It is anticipated that operational impacts *may affect*, *but are not likely to adversely affect* threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, *may affect*, *but are not likely to adversely affect* threatened and endangered species at the programmatic level, as they would be conducted infrequently, 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, as practicable and feasible, areas where these species are known to occur; therefore, listed species may be affected, but are not likely to be adversely affected 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.

Threatened and endangered species may be affected, but are not likely to be adversely affected at the programmatic level, 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, as practicable and feasible, 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 impacts 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 impacts to threatened and endangered species as a result of implementation of this alternative could be as described below.

<u>Deployment Impacts</u>

As explained above, implementation of deployable technologies *may affect*, but is not *likely to adversely affect*, threatened and endangered species at the programmatic level 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, as practicable and feasible, 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 at the programmatic level as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid, as practicable and feasible, areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 16, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no effects* to threatened and endangered species at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

15.2.7. Land Use, Recreation, and Airspace

15.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Texas 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.

15.2.7.2. 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 15.2.7-1. As described in Section 15.2, 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 15.2.7-1: 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 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 *potentially significant*, but with mitigation is *less than significant*.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation 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 *potentially significant*, but with mitigation is *less than significant*.	Restricted access to recreation land or activities.	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, vibration, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation 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 *potentially significant*, but with mitigation is *less than significant*.	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

15.2.7.3. 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 ROWs or easement, as required. 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 rights-of-way or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 15.2.7-1, *less than significant impacts* at the programmatic level would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of 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 right-of-way, 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 15.2.7-1, *less than significant impacts* at the programmatic level would be anticipated, as any new land use would be small-scale and short-term during the construction phase.

Loss of Access to Public or Private Recreation Land or Activities

The deployment, operation, and maintenance of facilities and the acquisition of ROWs 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 above ground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 15.2.7-1, *less than significant* impacts at the programmatic level would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other above ground 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 15.2.7-1, *less than significant* impacts would be anticipated at the programmatic level 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 15.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, FirstNet would be unlikely to have a significant impact on airspace resources. Therefore the potential impacts to airspace is expected to be *less than significant* at the programmatic level.

15.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to land use, recreation, and airspace resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of *no impacts* to *less than significant* impacts depending on the deployment scenario or site-specific conditions. 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 Progammatic 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 at the Programmatic Level* below.
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
    - Airspace: *No impacts* at the programmatic level to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 15.1.7.5 Obstructions to Airspace Considerations).
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.

    - Airspace: It is anticipated that there would be *no impacts* at the programmatic level 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 15.1.7.5 Obstructions to Airspace Considerations).
- New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
    - Airspace: Installation of new poles would have *no impact* at the programmatic level on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: *No impacts* at the programmatic level to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
    - Airspace: *No impacts* at the programmatic level are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would *not impact* at the programmatic level recreation because it would not impede access to recreational resources
    - Airspace: Lighting of dark fiber would have *no impacts* at the programmatic level on airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
    - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level at the Programmatic Level* 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

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 15.1.7.5 Obstructions to Airspace Considerations).

  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
    - Land Use: See *Activities with the Potential to Have Impacts at the Programmatic Level* below
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below
    - Airspace: *No impacts* at the programmatic level to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 15.1.7.5 Obstructions to Airspace Considerations).
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building
    - Land Use: There would be *no impacts* at the programmatic level to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
    - Airspace: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: *No impacts* at the programmatic level to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

        - Land Use: It is anticipated that there would be *no impacts* at the programmatic level to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
        - Recreation: See *Activities with the Potential to Have Impacts at the Programmatic Level* below.
        - Airspace: See *Activities with the Potential to Have Impacts at the Programmatic Level* 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 impacts* at the programmatic level on land use, recreation, or airspace.

Activities with the Potential to Have Impacts at the Progammatic 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 are anticipated – see previous section.
    - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) rights-of-way or easements and the potential construction of access roads.
        - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously undisturbed rights-of-way or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.

    - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - Airspace: *No impacts* at the programmatic level are anticipated – see previous section.
  - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on 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 are anticipated – see previous section.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
    - Airspace: *No impacts* are anticipated – see previous section.
- Wireless Projects
  - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.

    - Airspace: Installation of new wireless towers could result in *potential impacts* to airspace if towers exceed 200 feet AGL or meets the other criteria listed in Section 15.1.7.5 Obstructions to Airspace Considerations. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Texas' airports.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
    - Land Use: *No impacts* at the programmatic level are anticipated – see previous section.
    - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
    - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: *No impacts* are anticipated – see previous section.
    - Recreation: *No impacts* are anticipated – see previous section.
    - Airspace: Implementation of Deployable Aerial Communications Architecture could result in potential impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Texas airports (See obstruction criteria in Section 15.10.5.3 Obstructions to Airspace Considerations). Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: *No impacts* at the programmatic levelare 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 could *potentially impact* airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. *Potential impacts* to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be *less than significant* at the programmatic level due to the temporary and small-scale nature of deployment activities. Additionally FirstNet (or its network partners), would prepare an OE/AAA for any proposed tower that might affect navigable airways or flight patterns of an airport. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. Operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. It is anticipated that there would be *no impacts* at the programmatic level to land use, recreation resources, or airspace associated with routine inspections, assuming that the same access roads used for deployment are also used for inspections.

The degree of change in the visual environment (see Section 15.2.8, 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.

15.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in *less than significant impacts* at the programmatic level to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected; however, impacts would be *less than significant* at the programmatic level due to the temporary nature of likely deployment activities. If deployment 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 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* to land use, recreation resources, or airspace at the programmatic level. Environmental conditions would therefore be the same as those described in Section 15.1.7, Land Use, Recreation, and Airspace.

15.2.8. Visual Resources

15.2.8.1. Introduction

This section describes potential impacts to visual resources in Texas 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.

15.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 15.2.8-1. As described in Section 15.2, 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 visual resources addressed in this section are presented as a range of possible impacts.

Table 15.2.8-1: 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 *potentially significant*, but with mitigation is *less than significant*.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

15.2.8.3. 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 Texas, residents and visitors travel to many National and State parks, such as Big Bend National Park for its desert vistas and Padre Island National Seashore to enjoy the beach and water activities in the Gulf of Mexico. 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 15.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered *potentially significant* at the programmatic level 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 a 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 15.2.8-1, lighting that illuminates the night sky on a regional basis, 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 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.

15.2.8.4. 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 miigation measure 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 Progammatic 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* and would result in *no impacts* to visual resources 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 lightning.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* at the programmatic level on visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would *not impact* at the programmatic level to visual resources as long as 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 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 visual resources, it is anticipated that this activity would have *no impact* at the programmatic level on visual resources.

Activities with the Potential to Have Impacts at the Progammatic Level

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs , huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development in or next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public 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 have *no impact* at the programmatic level visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shore to accept submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be 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 not likely result in additional *impacts* to visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction or staging or landing areas, results in vegetation removal or 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 to visual resources are anticipated to be *less than significant* impacts at the programmatic level .at the programmatic level due to the temporary and small-scale nature of deployment activities. As discussed above, potential impacts to night skies from lighting are expected to be *less than significant with BMPs and mitigation measures incorporated* 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.

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 with BMPs and mitigation measures incorporated* at the programmatic level 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.

15.2.8.5. 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. Therefore, 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 15.1.8, Visual Resources.

15.2.9. Socioeconomics

15.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Texas 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.

15.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 15.2.9-1. As described in Section 15.2, 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.

Table 15.2.9-1: Impact Significance Rating Criteria for Socioeconomics at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Indiscernible impact to property values and/or rental fees.	*No impacts* to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations, 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 *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Indiscernible economic change.	No change to spending, income, industries, and public revenues.
	Geographic Extent	Regional impacts observed throughout the state/ territory.		Effects realized at one or multiple isolated cities/towns, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with 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 *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

15.2.9.3. 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 Texas. Median values of owner-occupied housing units in the 2009–2013 period ranged from nearly $200,000 in the greater Austin area, to just under $80,000 in the McAllen area. These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic emissions. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing *no effect* beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, *may affect* property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to Changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partner(s) 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, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor, direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet 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 across Texas. The average unemployment rate in 2014 was 5.1 percent, lower than the national rate of 6.2 percent. County-level unemployment rates were lower than the national rate (that is, better employment performance) in most counties.

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 be *less than significant* at the programmatic level based on the criteria in Table

15.2.2-1 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.

15.2.9.4. 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 15.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because they represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 15.2.9-1. 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 summarizes how the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
    - Impacts to Employment – Similarly, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, at the programmatic level 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, vibration, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be *less than significant* at the programmatic level.
- Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be *less than significant* at the programmatic level.
- Impacts to Employment – Similarly, at the programmatic level 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, at the programmatic level expenditures for these projects would generate temporarily a *less than significant* number of jobs regionally and statewide.

In general, the abovementioned activities would have *less than significant* beneficial socioeconomic impacts at the programmatic level. The discussion above characterized the impacts of each type of activity. The socioeconomic impacts of all activities considered together would also be *less than significant* at the programmatic level. Even when considered together, the impacts would be very small relative to the total economic activity and property value of any region or the state. In addition, with the possible exception of property values, all deployment impacts would be limited to the construction phase. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be *less than significant* at the programmatic level, as 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.

Operation Impacts

Activities with the Potential to Have Impacts at the Programmatic Level

As described in Section 15.1.2, 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 at the programmatic level 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 at the programmatic level.

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.

15.2.9.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity and therefore *less than significant* at the programmatic level.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. These potential impacts are anticipated to be *less than significant* at the programmatic level as described above. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, 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, vibration, and traffic) that could negatively affect the value of surrounding properties. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be more numerous, present over a larger geographic extent, and used with greater frequency and duration. These impacts, if they occur, would be *less than significant* at the programmatic level as they would be limited to a relatively small number of sites within 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.

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* at the programmatic level to socioeconomics as a result of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 15.1.9, Socioeconomics.

15.2.10. Environmental Justice

15.2.10.1. Introduction

This section describes potential impacts to environmental justice in Texas associated with construction/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.

15.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 15.2.10-1. As described in Section 15.2, 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.

Table 15.2.10-1: Impact Significance Rating Criteria for Environmental Justice at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and *adverse effects* on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level, as opposed to throughout the state or territory.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

15.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas That Have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment" (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise and Vibration, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, vibration, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on *adverse effects*. However, telecommunications projects, such as those proposed by FirstNet, may 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 15.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Site-specific analysis to evaluate environmental justice may be required depending on the site conditions, including the presence of low-income populations or minority populations, the type of deployment, or any other permits or permissions necessary to perform the work. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 15.1.10.4) as having

Moderate Potential or High Potential for environmental justice populations would particularly warrant further screening. As discussed in Section 15.1.10.3, Environmental Setting: Minority and Low-Income Populations, Texas' population has a considerably higher percentage for the All Minorities group than the region or the nation, and has higher percentages of individuals identifying as Hispanic or Some Other Race. The poverty rate of Texas is slightly below the rate for the region and above the rate for the nation. A large proportion of Texas has High Potential for environmental justice populations. These High Potential areas occur both within and outside of the 10 largest population concentrations. A higher proportion of counties along or near the state's southwestern border, the international border shared with Mexico, have High Potential for environmental justice populations. The distribution of areas with Moderate Potential for environmental justice populations is fairly even across the state, excepting the southwestern border area. Further analysis using the data developed for the screening analysis in Section 15.1.10.4, 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 (EIA, 2015e; USEPA, 2014d).

Site-specific analysis may be required depending on the site conditions, the type of deployment, or any other permits or permissions necessary to perform the work. This site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts at the Progammmatic Level" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

15.2.10.4. 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, 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 depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to environmental justice under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would *not affect* at the programmatic level environmental justice communities.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have *no impacts* on environmental justice. If physical access 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 resulting impacts on environmental justice communities.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve new ground disturbance, and impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact socioeconomics, it is anticipated that this activity would have *no impact* on environmental justice.

Activities with the Potential to Have Impacts at the Programmatic Level

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, vibration, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise, vibration, and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.

- New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited 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 on shores or the banks of waterbodies that accept submarine cable could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise, vibration, and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise, vibration, and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise, vibration, and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise, vibration, and dust could be generated, and traffic could be temporarily disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, vibration, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be *less than significant* at the programmatic level, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. 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 have *no impacts* at the programmatic level, as the intensity of these activities would be low (low potential for objectionable effects such as noise, vibration, and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be *less than significant* at the programmatic level given the short-term nature and limited geographic scope for individual activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.10.5. 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 of associated with wired or wireless projects discussed above under the Preferred Alternative.

Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise, vibration, and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level because they would be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, vibration, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be *less than significant* at the programmatic level as operations are expected to be temporary in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be *no impacts* to environmental justice at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.10, Environmental Justice.

15.2.11. Cultural Resources

15.2.11.1. Introduction

This section describes potential impacts to cultural resources in Texas 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.

15.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 15.2.11-1. The categories of impacts are defined at the programmatic level as an *adverse effect; mitigated adverse effect; effect, but not adverse;* and *no effect*. These impact categories are comparable to those defined in *36 CFR § 800*, Secretary of Interior's Standards and Guidelines for Archaeology and Historic Preservation (*NPS 1983*), and the United States (U.S.) National Park Service's *National Register Bulletin: How to Apply the National Register Criteria for Evaluation* (*NPS 2002*). Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 15.2.11-1: Effect Significance Rating Criteria for Cultural Resources at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect[a]**	**Effect, but not Adverse**	**No Effect**
Physical damage to and/or destruction of historic properties[b]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects 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.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	Mitigated Adverse Effect[a]	Effect, but not Adverse	No Effect
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "*Less than Significant with Mitigation Measures Incorporated*," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable *adverse effects* to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including American Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[b] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian Tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

15.2.11.3. 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 15.2.11-1, direct deployment impacts could be potentially adverse 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 that archaeological sites and historic properties are present throughout Texas, some deployment activities may be in these same areas, in which case BMPs (see Chapter 16) would help avoid or minimize the potential effects.

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 by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

15.2.11.4. Potential Effectss 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 in a range of *no effects* to effects, but not adverse, depending on the deployment scenario or site-specific conditions. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Effects at the Progammatic 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 impacts* to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* on cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have *no impacts* to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have *no impact* on cultural resources.

Activities with the Potential to Have Effects at the Progammatic Level

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas, shorelines and creekbanks in Texas have the potential to contain prehistoric archaeological sites, as well as sites associated with the state's significant maritime history since European colonization, such as shipwrecks. 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 historical sites (archaeological deposits are frequently associated with bodies of water, and Texas has numerous maritime and riverine archaeological sites associated with its 16^{th} through 19^{th} century European settlement and development), and the associated network structures could have visual effects on historic properties.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be *no impacts* to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
  - Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in impacts to 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 San Antonio and Galveston, that have larger numbers of historic buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These impacts could affect, but not adversely affect, cultural resources at the programmatic level 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 additional 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 described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *no effect* at the programmatic level 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 at the programmatic level. 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.

15.2.11.5. Alternatives Effect Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this Alternative could be as described below.

Deployment Effects

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources at the programmatic level 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 at the programmatic level. No *adverse effects* would be expected to either site access or viewsheds due to the temporary nature of expected activities at the programmatic level. 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 at the programmatic level, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur; however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. Therefore, there would be *no effects* to cultural resources at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.11, Cultural Resources.

15.2.12. Air Quality

15.2.12.1. Introduction

This section describes potential impacts to Texas' 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.

15.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Texas' air quality were evaluated using the significance criteria presented in Table 15.2.12-1. As described in Section 15.2, 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 Texas' air quality addressed in this section are presented as a range of possible impacts.

Table 15.2.12-1: Impact Significance Rating Criteria at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with 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 *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	Negligible emissions would occur for any pollutant within an attainment area, but would not cause a NAAQS exceedance and would not trigger major source permitting.	Emission increases would be infrequent or absent, mostly immeasurable; projects conform to SIP.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary.

NA = Not Applicable

15.2.12.3. 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 Texas that are in maintenance or nonattainment for one or more criteria pollutants, particularly, ozone is a state-wide issue (see Section 15.1.12, Air Quality).

Based on the significance criteria presented in Table 15.2.12-1, air emission impacts would likely be *less than significant* given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. At the programmatic level, l*ess than significant* emissions could occur for any of the criteria pollutants within attainment areas in Texas; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Texas (Figure 15.1.12-1) 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).

15.2.12.4. Potential Impacts of the Preferred Alternative at the Programmatic Level

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

Potential Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from *no impacts* to *less than significant* impacts 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 Progammatic 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-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 equipment are expected to have minimal to *no impact* on ambient air quality concentrations.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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 air quality resources, it is anticipated that this activity would have *no impact* on air quality.

Activities with the Potential to Have Impacts at the Progammatic 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 conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If the delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
- Deployable Technologies
  - The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be *less than significant* at the programmatic level due to the limited nature of the deployment. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be *less than significant* impacts at the programmatic level to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur; however, they would be *less than significant* at the programmatic level as they would still be limited in nature. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.12.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Potential Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be *less than significant* at the programmatic level based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations, would dictate the concentrations and associated impacts. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to ambient air quality at the programmatic level. By not deploying the NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

15.2.13. Noise and Vibration

15.2.13.1. Introduction

This section describes potential noise and vibration impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Texas. 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.

15.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise and vibration impacts of the Proposed Action were evaluated using the significance criteria presented in Table 15.2.13-1. As described in Section 15.2, 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 Texas addressed in this section are presented as a range of possible impacts.

Table 15.2.13-1: Impact Significance Rating Criteria for Noise and Vibration at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise and vibration levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA. Vibration levels would exceed 65 VdB for human receptors and 100 VdB for buildings.	Effect that is *potentially significant*, but with mitigation is *less than significant*.	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)

15.2.13.3. Description of Environmental Concerns

Increased Noise and Vibration Levels

The Proposed Action has the potential to generate noise and vibration during construction and operation of various equipment used for deployment. These noise and vibration levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise and vibration could cause impacts on residential areas, or other facilities that are sensitive to noise and vibration, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 15.1.13, Noise and Vibration).

Based on the significance criteria presented in Table 15.2.13-1, 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 and vibration levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise and vibration effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise- and vibration-sensitive receptors. However, given that much of the construction and operation of the Proposed Action would often occur in populated areas, FirstNet would not be able to completely avoid noise or vibration impacts.

15.2.13.4. 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 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 Progammatic 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 vibration generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no noise or vibration impacts, 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 vibration would be emitted during installment of this equipment. Noise and vibration caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to *no impact* on vibration or the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise or vibration resources, it is anticipated that this activity would have *no impact* on noise or vibration.

Activities with the Potential to Have Impacts at the Progammatic Level

Construction, deployment, and operation activities related to the Preferred Alternative could create noise and vibration impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to noise and vibration include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise and vibration levels from the use of heavy equipment and machinery.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other

  - associated facilities to house plant equipment would be short-term and could result in increased noise and vibration levels from the use of vehicles and machinery.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increased 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 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 vibration associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the vibration and noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise and vibration over baseline levels temporarily.
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise and vibration. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise and vibration levels.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact vibration and the local noise environment temporarily.
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise and vibration generated. For example, mobile equipment deployed via heavy trucks could generate noise and vibration from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft) generate noise and vibration during all phases of flight, including takeoff, landing, and flight operations over necessary areas that could impact vibration and the local noise environment.

In general, noise and vibration from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be *less than significant* at the programmatic level due to the temporary duration of deployment activities. Additionally, pre-existing noise and vibration levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would *be less than significant* at the programmatic level and similar to several of the deployment activities related to routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise and vibration. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise 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.

15.2.13.5. 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 Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise and vibration impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise and vibration from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise and vibration levels. Several vehicles traveling together could also create short-term noise and vibration impacts on residences or other noise- and vibration-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise and vibration during all phases of flight. Aerial technologies would have the highest level of noise and vibration impact if they are required to fly above residential areas, areas with a high concentration of noise- and vibration-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be *less than significant* at the programmatic level, given that these activities are of low-intensity and short duration. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise and vibration 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 and vibration impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate *less than significant* short-term impacts at the programmatic level on any residential areas or other noise- and vibration-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise and vibration levels would quickly return to baseline levels. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be *no impact* to vibration and ambient noise at the programmatic level. By not deploying the NPSBN, FirstNet would avoid generating noise and vibration from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

15.2.14. Climate Change

15.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable FirstNet installations and infrastructure in Texas 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 partners would require, as practicable or feasible, to avoid or minimize potential impacts.

15.2.14.2. 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 15.2.14-1. As described in Section 15.2, 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 15.2.14-1: Impact Significance Rating Criteria for Climate Change at the Programmatic Level

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Contribution to climate change through GHG emissions	Magnitude or Intensity	See discussion below in Section 15.2.14.5, Potential Impacts of the Preferred Alternative	Effect that is *potentially significant*, but with mitigation is *less than significant*.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent			Global impacts observed.	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 *potentially significant*, but with mitigation is *less than significant*.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

15.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. For an average of seven days per year, maximum temperatures reach more than about 95 °F in the Northern Plains. These high temperatures are projected to occur much more frequently with days over 100 °F projected to double in number in the Northern Plains even in a low emissions scenario. Increases are also expected in the number of nights with minimum temperatures higher than 60 °F in the north part of the plains. These increases in extreme heat will have many negative consequences, including increases in surface water losses, heat stress, and demand for air conditioning. (USGCRP, 2014a)

Air Temperature

Figure 15.2.14-1 and Figure 15.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Texas from a 1969 to 1971 baseline.

Bsk – Figure 15.2.14-1 shows that by mid-century (2040 to 2059), temperatures in Bsk region of Texas under a low emissions scenario would increase by approximately 4 °F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in this region would increase by approximately 5 °F or 6 °F depending on the portion of the region. (USGCRP, 2009)

Figure 15.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Bsk region of Texas, temperatures would increase by approximately 9 °F or 10 °F. (USGCRP, 2009)

Bsh – Temperatures in this region are expected to increase by mid-century (2040 to 2059) by 4 °F for most of the region and by 3 °F in the southern portion of the region under a low emissions scenario. By the end of the century under a low emissions scenario temperatures are expected to increase 5 °F in the majority of the region and by 5 °F in the southern portion of the region. (USGCRP, 2009)

Under a high emissions scenario, temperatures will increase by 5 °F by mid-century in the Bsh region, and by 8 °F or 9 °F depending on the portion of the region. (USGCRP, 2009)

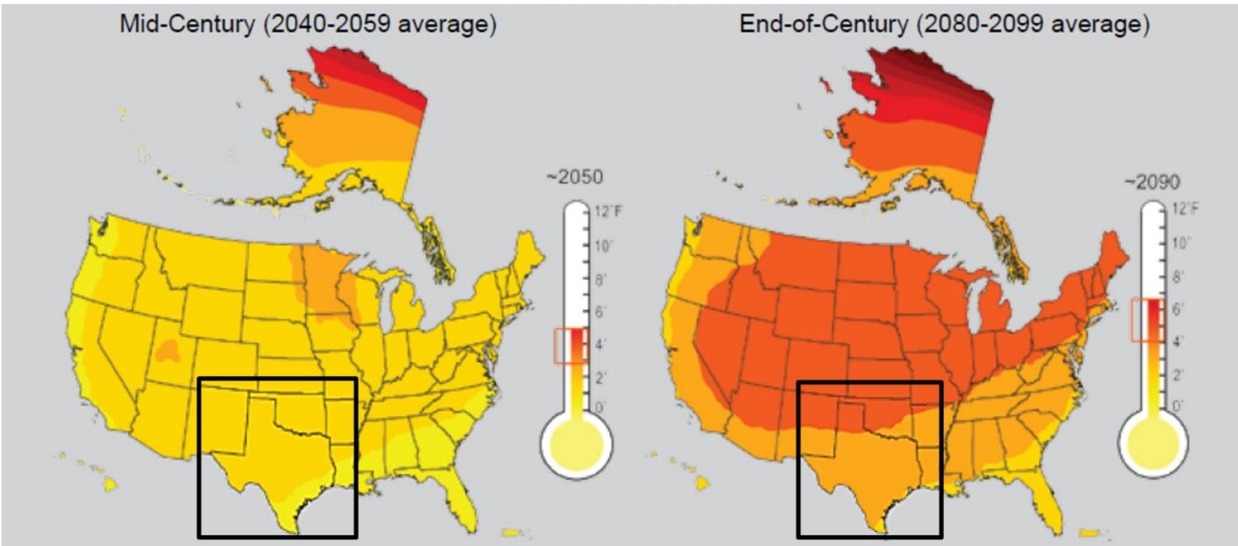
Bwh – By mid-century, temperatures in the Bwh region are expected to increase by 4 °F or 5 °F under a low emissions scenario depending on the portion of the region. (USGCRP, 2009)

Under a high emissions scenario temperatures are projected to increase by 5 °F by mid-century, and by the end of the century temperatures are projected to increase 9 °F. (USGCRP, 2009)

Bwk – Temperatures in this region are expected to increase at the same rate as the Bwh region by mid-century and the end of the century under low and high emissions scenarios. (USGCRP, 2009)

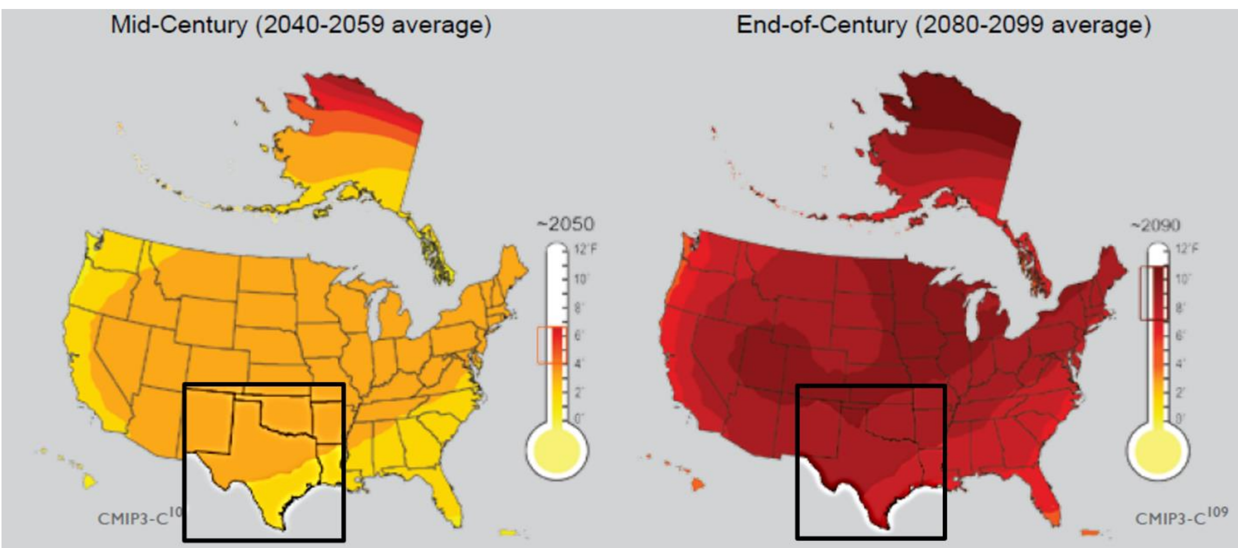
Dfa – Temperatures in the Dfa region are expected to increase at the same rate as the Bsh region by mid-century and the end of the century under a low emissions scenario. (USGCRP, 2009)

Under a high emissions scenario, temperatures in the Dfa region are expected to increase 4 °F or 5 °F by mid-century depending on the portion of the region. In this scenario by the end of the century, temperatures in the southern most portion of the Dfa region are expected to increase 7 °F and the temperatures in the remainder of the region will increase 8 °F or 9 °F depending on the area of the region. (USGCRP, 2009)



Source: (USGCRP, 2009)

Figure 15.2.14-1: Texas Low Emission Scenario Projected Temperature Change



Source: (USGCRP, 2009)

Figure 15.2.14-2: Texas High Emission Scenario Projected Temperature Change

Precipitation

Winter and spring precipitation is projected to increase in the northern states of the Great Plains region relative to a 1971-2000 average. In central areas, changes are projected to be small relative to natural variations. Projected changes in summer and fall precipitation are also small except for summer drying in the central Great Plains. The number of days with heavy precipitation is expected to increase by mid-century, especially in the Northern Plains. (USGCRP, 2014a)

In Texas there is an expected 10 period increase in the number of consecutive dry days under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario, Texas is projected to experience a 20 to 30 percent increase in the number of consecutive dry days. An increase in consecutive dry days could lead to drought. (USGCRP, 2014a)

Figure 15.2.14-3 and Figure 15.2.14-4 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 15.2.14-3 shows seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions means more than 70 percent cuts from current levels by 2050. (USGCRP, 2014b)

Figure 15.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014b)

Bsk - Figure 15.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation is expected to remain constant in winter, spring and fall in the Bsk region of Texas. In spring, precipitation is expected to remain constant or increase 10 percent depending on the portion of the region. (USGCRP, 2014b)

Figure 15.2.14-4 shows that if emissions continue to increase, winter precipitation in the Bsk region could remain constant, decrease 10, 20, or 30 percent over the period 2071 to 2099 depending on the portion of the region. In spring and summer, precipitation in this scenario will remain constant, or decrease 10 or 20 percent depending on the portion of the region. Fall precipitation is expected to decrease 10 percent under a high emissions scenario. (USGCRP, 2014b)

Bsh – Under a low emissions scenario, precipitation in spring, summer and fall is expected to remain constant in the Bsh region. In winter, precipitation is expected to remain constant or decrease 10 percent depending on the portion of the region. (USGCRP, 2014b)

Under a high emissions scenario, precipitation is expected to decrease 20 percent in the majority of the Bsh region while a small portion will have a precipitation decrease of 10 percent in winter. In spring, precipitation is expected to decrease 10 or 20 percent depending on the portion of the region. Summer and fall precipitation may remain constant or decrease 10 percent depending on the portion of the Bsh region. (USGCRP, 2014b)

Bwh – Winter precipitation in the Bwh region under a low emissions scenario is expected to remain constant or decrease 10 percent depending on the portion of the region. Spring, summer and fall precipitation changes are not projected to be larger than could be expected from natural variability. (USGCRP, 2014b)

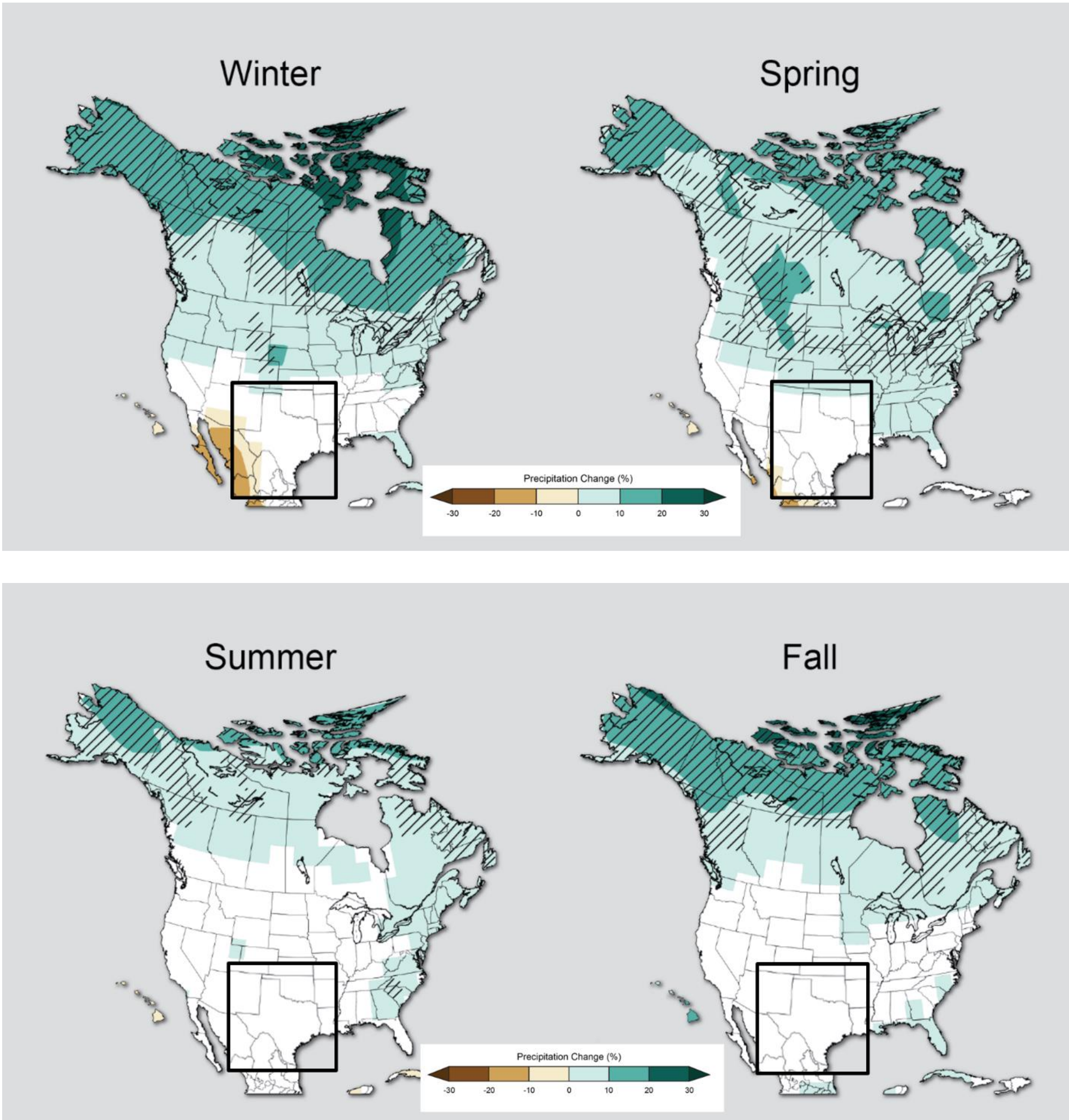
Winter precipitation is expected to decrease 20 or 30 percent depending on the portion of the Bwh region under a high emissions scenario. Spring precipitation is expected to decrease 20 percent while winter precipitation is expected to decrease 10 percent. There are no expected changes in summer precipitation under a high emissions scenario other than natural variability. (USGCRP, 2014b)

Bwk – Precipitation changes in the Bwk region are consistent with changes in the Bwh region under a low emissions scenario. (USGCRP, 2014b)

In winter and spring under a high emissions scenario, winter and spring precipitation is expected to decrease 20 or 30 percent depending on the portion of the region. There are no anticipated changes to summer precipitation other than natural variability. Fall precipitation is expected to remain constant or decrease 10 percent depending on the portion of the region. (USGCRP, 2014b)

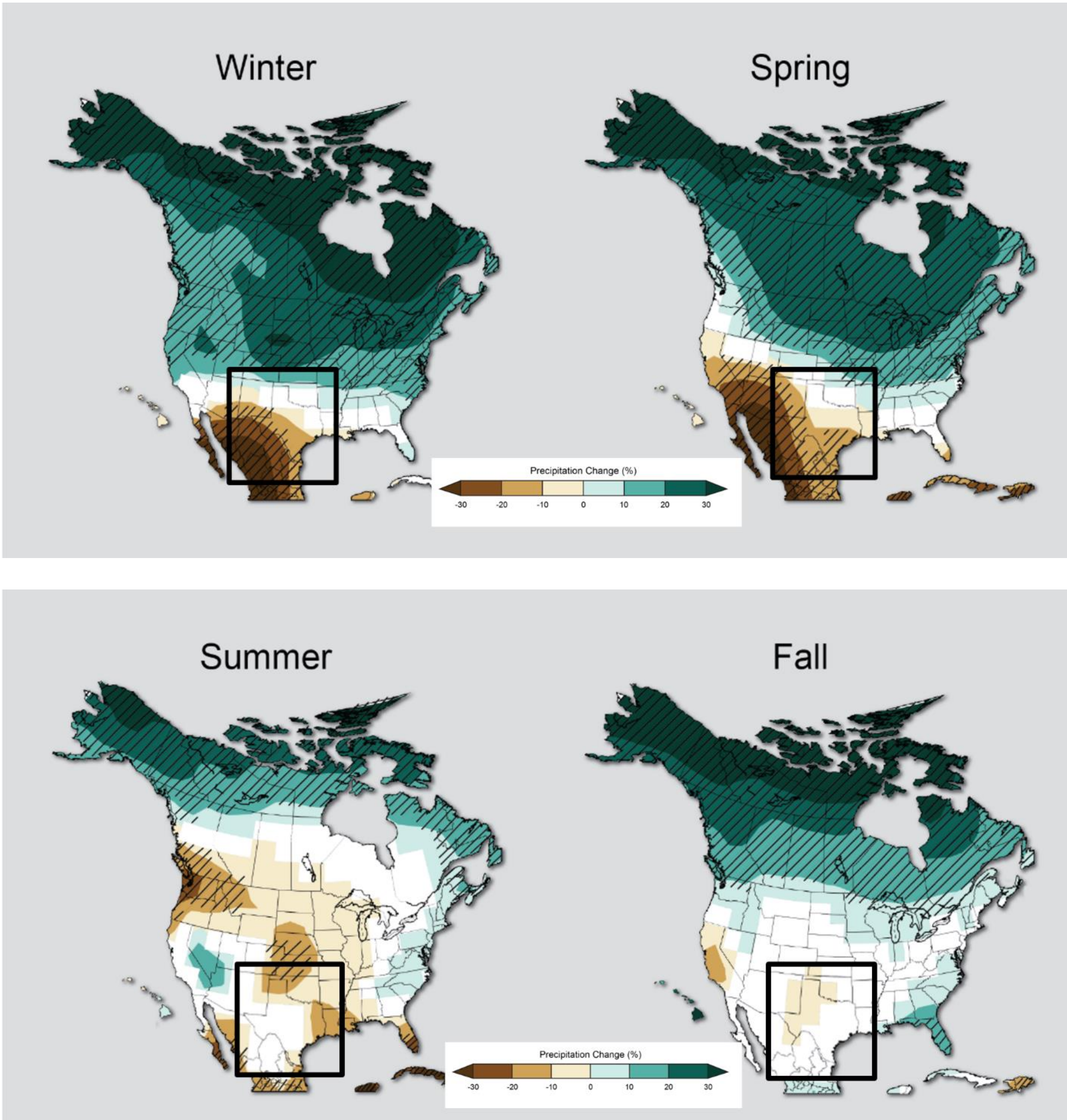
Dfa – There are no expected changes in precipitation in the Dfa region under a low emissions scenario. (USGCRP, 2014b)

Under a high emissions scenario, winter, spring and summer precipitation is expected to remain constant, or decrease 10 or 20 percent depending on the portion of the Dfa region. Fall precipitation will remain constant or decrease 10 percent. (USGCRP, 2014b)



Source: (USGCRP, 2014b)

Figure 15.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014b)

Figure 15.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Sea Level

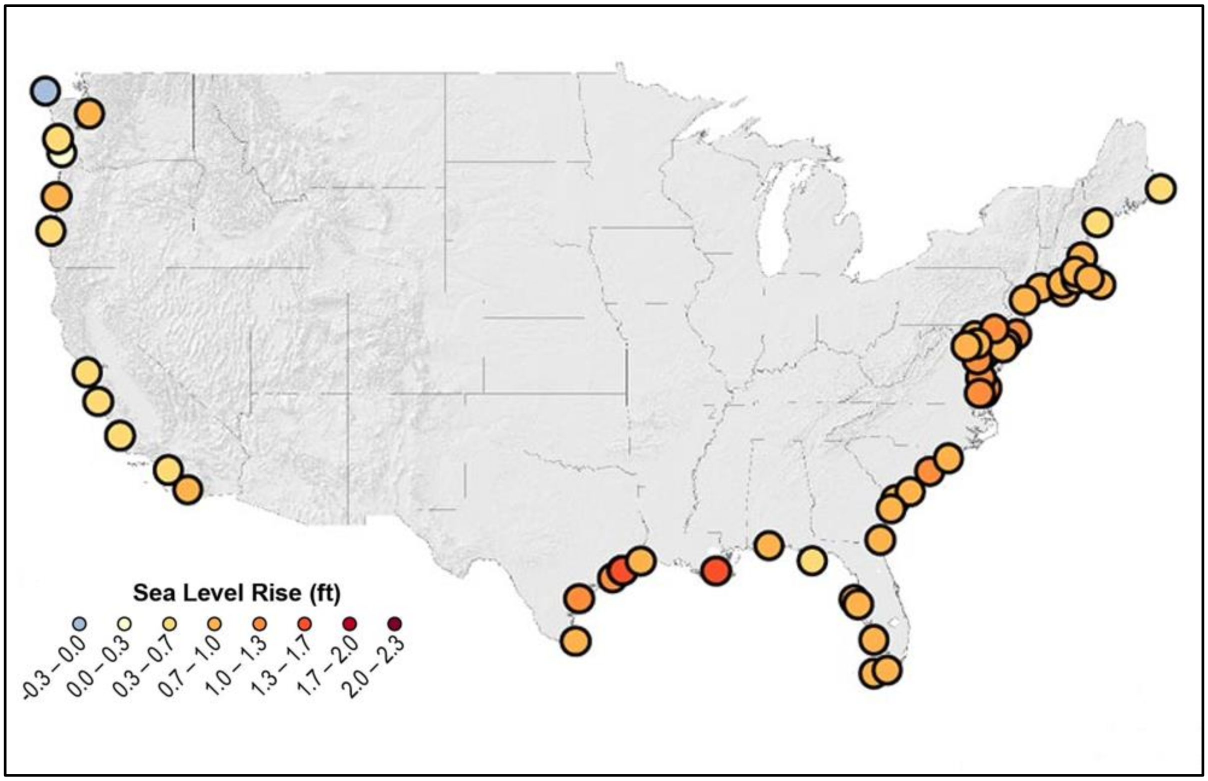
Several factors would continue to affect sea level rise in the future. Glacier melt adds water to the ocean, and increasing ocean temperatures result in thermal expansion. Worldwide, “glaciers have generally shrunk since the 1960s, and the rate at which glaciers are melting has accelerated over the last decade. The loss of ice from glaciers has contributed to the observed rise in sea level" (USEPA, 2012b). 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" (USEPA, 2012b). Sea level and currents could be influenced by the amount of heat stored in the ocean. (USEPA, 2012b)

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 lever 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). In the National Climate Assessment (NCA) potential sea level rise scenarios were reported. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA; USGS; SERPD; and USACE, 2012). Figure 15.2.14-5 and Figure 15.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 15.2.14-5 shows an 8 inch global sea level rise above 1992 levels by 2050 and Figure 15.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014c).

Bsh – Figure 15.2.14-5 presents an 8-inch global average sea level rise above 1992 levels would result in a 0.7 to 1.0 foot sea level rise in 2050 along the coast of Texas. Figure 15.2.14-6 indicates that a 1.24-foot sea level rise above 1992 level would result in 1.3 to 1.7 foot sea level rise in 2050 along the Bsh region on the coast of Texas. (USGCRP, 2014c)

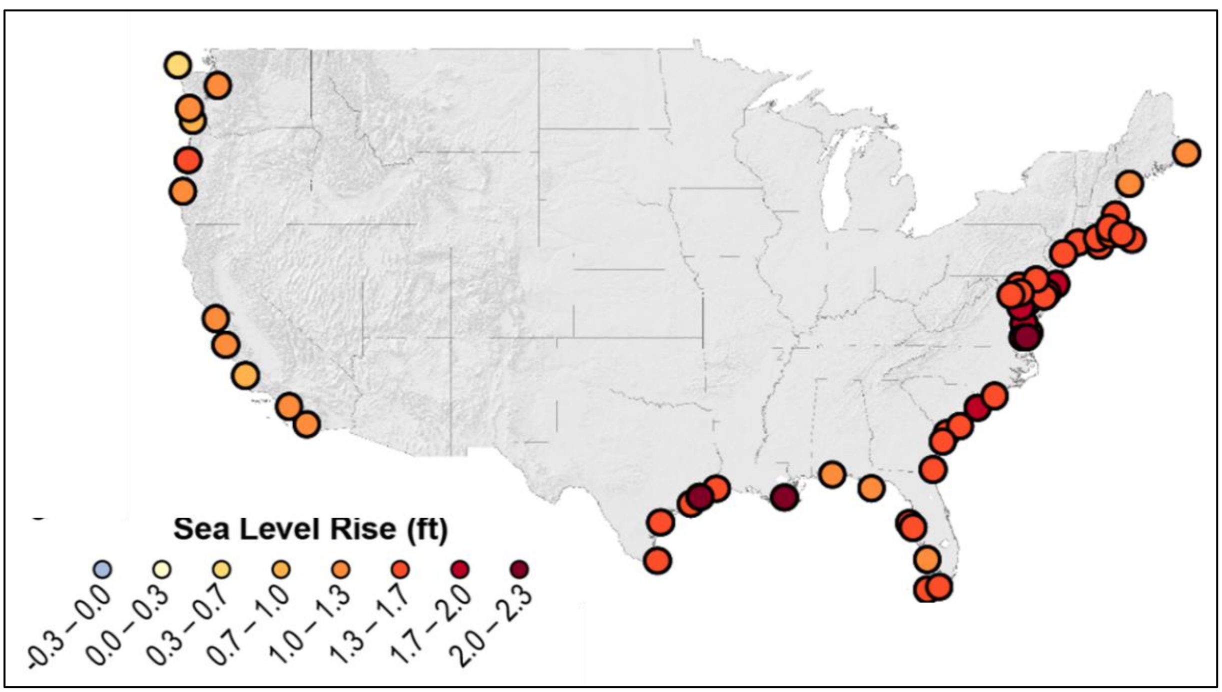
Dfa – An 8-inch global average sea level rise above 1992 levels would result in a 0.7 to 1.7 foot sea level rise in 2050 along the Dfa region of Texas. A 1.24-foot sea level rise above 1992 level would result in a 1.3 to 2.3 foot sea level rise in 2050 along the (Dfa) region on the coast of Texas. (USGCRP, 2014c)

Bsk, Bwh, Bwk – These regions of Texas are not affected by sea level rise.



Source: (USGCRP, 2014c)

Figure 15.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050



Source: (USGCRP, 2014c)

Figure 15.2.14-6: 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, 2014d)

United States coastal waters are expected to experience more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of storms that make landfall) (USGCRP, 2014d). Changes in hurricane intensity are difficult to project because there are contradictory effects at work. Warmer oceans increase storm strength with higher winds and increased precipitation. However, changes in wind speed and direction with height are also projected to increase in some regions; this tends inhibit storm formation and growth. Current research suggests stronger, more rain-producing tropical storms and hurricanes are generally more likely, though such storms may form less frequently; ultimately, more research would provide greater certainty (USGCRP, 2009).

15.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO_2 emissions from fossil fuels.

Based on the impact significance criteria presented in Table 15.2.14-1, 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 on-site 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.

In Texas, changes in average temperature and precipitation amounts, coupled with rising sea levels, may potentially shift agricultural production, or could change regional water resource distribution. Increased storms and rising sea levels may cause coastal erosion to Texas beaches, inundate coastal wetlands, and cause saltwater intrusion into freshwater aquifers (USGCRP, 2014e). In inland areas of Texas already 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, soil erosion, and negatively impact water quality.

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 coast and inland Texas are 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. Stronger storms may also increase the potential for damage from high winds and wind-borne debris. To mitigate these impacts, FirstNet would seek to locate fixed assets such as cell towers out of flood plains and other at-risk areas, or elevate them such that they can continue operating during storm events. Energy sources such as powerlines and stand-by generators would be similarly elevated or otherwise protected. Towers would also be rated for stronger hurricane-force winds and hardened to protect them from strikes by wind-borne debris.

In inland areas of Texas out of the immediate path of coastal 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 as well as severe flooding during hurricanes. FirstNet would locate fixed assets out of flood plains and other areas that are likely to be inundated or prone to flooding during these extreme weather events.

Urban areas in particular will be at risk of increased intensity and duration of heat waves, particularly in urban areas such as Houston where heat waves would be magnified by the urban heat island. Extended periods of extreme heat may impede the operation of the grid (DOE, 2015) and overwhelm the capacity of on-site equipment needed to keep microwave and other transmitters cool. FirstNet would ensure that there will be sufficient electrical back-up generators and cooling capacity to keep systems running during these extreme weather events.

Based on the impact significance criteria presented in Table 15.2.14-1 climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

15.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

Given this assessment is programmatic and does not include any site-specific locations or deployment technology, it is impossible to determine the actual GHG emissions associated with any of the action alternatives. This information could only be captured once the site-specific information is determined. However, an assessment of potential impacts is provided in this section based on the potential emissions associated with the various activities that could occur as a result of the implementation of the Preferred Alternative in Texas, 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 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 Progammatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to climate change under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
  - Distribution of Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because these activities.

Activities with the Potential to Have Impacts at the Progammatic 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, or 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*; although geographically large (all 50 states and 5 territories) any one site would be limited in extent and emit minor levels of GHG emissions as explained in the analysis[163]. Land use 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

Climate change effects on the Preferred Alternative could be *potentially significant* to *less than significant with BMPs and mitigation measures incorporated* at the programmatic level 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.

[163] "The rule of reason and the concept of proportionality caution against providing an in-depth analysis of emissions regardless of the insignificance of the quantity of GHG emissions that would be caused by the proposed agency action."

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.

15.2.14.6. 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, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be *less than significant* 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 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 of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to *no impact* at the programmatic level on the deployed technology at the programmatic level 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. Therefore, there would be *no impacts* to GHG emissions or climate at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.14, Climate Change.

15.2.15. Human Health and Safety

15.2.15.1. Introduction

This section describes potential impacts to human health and safety in Texas 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.

15.2.15.2. 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 15.2.15-1. As described in Section 15.2, 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.

Table 15.2.15-1: 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 Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with 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 *potentially significant*, but with mitigation is *less than significant* at the programmatic level.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level, as opposed to throughout the state or territory.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

15.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that could sometimes be hazardous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 15.2.15-1, occupational injury impacts could be *potentially significant* if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of FirstNet work sites.

To protect occupational workers, OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2017).

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,[164] 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

[164] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016b)

employer specific workplace rules and operational practices (OSHA, 2017). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2002). 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.

Texas does not have an OSHA-approved “State Plan;” private and public sector occupational safety and health programs in Texas are enforced by OSHA. Public health is regulated by the TXDSHS. Therefore, TXDSHS defers all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination 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 15.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties. 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; the TCEQ makes environmental records available online through multiple databases accessible at www.tceq.texas.gov. Additional information is also available through the TXDSHS, or an equivalent commercial resource.

By screening sites for environmental contamination, 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, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination 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 Texas 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 DNREC may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRAs help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRAs take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

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 15.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a *less than significant* beneficial impact, 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.

15.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of *no impacts* to *less than significant* with mitigation, depending on the deployment scenario or site-specific activities. Chapter 16, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts at the Programmatic Level

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have *no impacts* to human health and safety under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be *no impacts* to human health and safety at the programmatic level.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have *no impacts* at the programmatic level on human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have *no impact* 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 include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and vibration 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 to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects

  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of 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, vibration, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes, vibration, and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of 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, and environmental contamination), 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, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise 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. It is anticipated that there would be *less than significant* 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 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.

15.2.15.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result *in less than significant impacts* at the programmatic level to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in *less than significant* impacts at the programmatic level to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise 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 at the programmatic level. 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 would 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 impact(s).

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. Thererfore, there would be *no impacts* to human health and safety at the programmatic level as a result of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 15.1.15, Human Health and Safety.

TX APPENDIX A – BIOLOGICAL RESOURCES

Table A-1: S1 Ranked Terrestrial Communities of Concern in Texas

USEPA Level III Ecoregion	Community	Distribution by County
Arizona/New Mexico Mountains	Maidenhair Fern-Sawgrass-New Mexico Muhly-Mat Rockspirea Spring Herbaceous Vegetation	Culberson and Presidio
Chihuahuan Deserts	Maidenhair Fern-Sawgrass-New Mexico Muhly-Mat Rockspirea Spring Herbaceous Vegetation	Culberson and Presidio
	Broom Snakebush/Mesa Dropseed Shrubland	El Paso
	Chairmaker's Bulrush-Clasping Yellowtops-(Puzzle Sunflower) Herbaceous Vegetation	Pecos and Reeves
	Douglas-fir/Netleaf Oak Forest	Brewster
	Dune Heliotrope-Sandmat species Sparse Vegetation	Brewster
	Rio Grande Cottonwood/Yerba Mansa Forest	El Paso
High Plains	Bulrush-Spikerush Marsh	Hemphill, Lipscomb and Wheeler
	Cottonwood/Switchgrass Floodplain Woodland	Deaf Smith, Hartley, Hemphill, Hutchison, Lipscomb, Ochiltree, Oldham and Wheeler
	Oklahoma Bladderpod Glade Sparse Vegetation	Dallam, Ochiltree, and Sherman
	Twisted Spikerush-Common Threesquare-Smooth Cordgrass-Sedges-(Swamp Verbena) Sandhill Fen Herbaceous Vegetation	Deaf Smith, Hartley, Hemphill, Hutchison, Lipscomb, Ochiltree, Oldham and Wheeler
Southwestern Tablelands	Bulrush-Spikerush Marsh	Hemphill, Lipscomb and Wheeler
	Cottonwood/Switchgrass Floodplain Woodland	Deaf Smith, Hartley, Hemphill, Hutchison, Lipscomb, Ochiltree, Oldham, and Wheeler
	Oklahoma Bladderpod Glade Sparse Vegetation	Dallam, Ochiltree, and Sherman
	Twisted Spikerush-Common Threesquare-Smooth Cordgrass-Sedges-(Swamp Verbena) Sandhill Fen Herbaceous Vegetation	Deaf Smith, Hartley, Hemphill, Hutchison, Lipscomb, Ochiltree, Oldham, and Wheeler
	Western Gypsum and Redbed Clay Prairie	Foard and Hardeman
Central Great Plains	Western Gypsum and Redbed Clay Prairie	Foard and Hardeman
Edwards Plateau	American Water-willow-Manyflower Marsh-pennywort-Rio Grande Bugheal-Gulf Coast Spikerush Herbaceous Vegetation	Kimble, Uvalde, Val Verde, and Zavala
	Central Texas Fen	Kerr and San Saba
	Plateau Oak-(Post Oak)/Little Bluestem Granite Woodland	Burnet, Gillespie, Llano, and Mason
	Texas Wild Rice Spring Run Vegetation	Hays
Texas Blackland Prairies	Eastern Gammagrass-(Switchgrass) Floodplain Herbaceous Vegetation	Austin, Delta, Franklin, Hopkins, Hunt, Smith, Titus, and Tyler
	Eastern Gammagrass-Switchgrass-Yellow Indiangrass-Michaelmas-daisy Herbaceous Vegetation	Collin, Dallas, Delta, Fannin, Hunt, and Lamar
	Silveus' Dropseed-Mead's Sedge Herbaceous Vegetation	Bowie, Fannin, Franklin, Hopkins, Lamar, Rains, and Titus

USEPA Level III Ecoregion	Community	Distribution by County
Southern Texas Plains	Big Alkali Sacaton Marsh	Cameron, Hidalgo, Starr, and Willacy
	Cane Bluestem-False Rhodesgrass Mixedgrass Prairie	Brooks, Cameron, Hidalgo, Starr, and possibly others
	Chaparro-Prieto-Cenizo-Guapilla Shrubland	Starr and Zapata
	Curly-mesquite-Texas Grama-Buffalo Grass-Texas Wintergrass Herbaceous Vegetation	Cameron, Jim Wells, Kleberg, Nueces, and Willacy
	Subtropical Texas Palmetto Woodland	Cameron and Hidalgo
	Tamaulipan Maritime Shrubland	Cameron and Willacy
	Texas Ebony Resaca Forest	Cameron, Hidalgo, and Willacy
Western Gulf Coastal Plain	Big Alkali Sacaton Marsh	Cameron, Hidalgo, Starr, and Willacy
	Cane Bluestem-False Rhodesgrass Mixedgrass Prairie	Brooks, Cameron, Hidalgo, Starr, and possibly others
	Curly-mesquite-Texas Grama-Buffalo Grass-Texas Wintergrass Herbaceous Vegetation	Cameron, Jim Wells, Kleberg, Nueces, and Willacy
	Subtropical Texas Palmetto Woodland	Cameron and Hidalgo
	Tamaulipan Maritime Shrubland	Cameron and Willacy
	Texas Ebony Resaca Forest	Cameron, Hidalgo, and Willacy
	Coastal Louisiana Chenier Forest	Chambers and Jefferson
	Colima-Panalero-Chapote Matorral	Aransas, Calhoun, and Matagorda
	Eastern Upland Coastal Prairie	Chambers and Jefferson
	Gulf Coast Salt Dome Hardwood Forest	Chambers, Galveston, and Jefferson
	Gulf Coast Shell Midden Woodland	Brazoria, Chambers, and Galveston
	Houston Coastal Prairie	Fort Bend, Galveston, and Harris
	Huisache-Spiny Florida Prickly-pear-Gulf Coast Wolfberry/Saltmeadow Cordgrass Shrubland	Chambers and Jefferson
	Sandhill Coastal Prairie	Austin and Colorado
	Seashore Crowngrass-Saltmeadow Cordgrass Oligohaline Herbaceous Vegetation	Chambers, Galveston, and Jefferson
	West Gulf Coastal Plain Cordgrass Dune Grassland	Chambers, Galveston, Harris, and Jefferson
	Wet Coastal Prairie/Marsh	Brazoria and Galveston
East Central Texas Plains	Eastern Gammagrass-(Switchgrass) Floodplain Herbaceous Vegetation	Austin, Delta, Franklin, Hopkins, Hunt, Smith, Titus, and Tyler
	Central Texas Post Oak Ecoregion Hillside Seepage Slope	Freestone and Leon
	Oklahoma Acidic Hillside Seep	Lamar
	Southern Texas Post Oak Ecoregion Stream Terrace Escarpment Seepage Bog	Gonzales and Guadalupe
	Texas Oakville Sandstone Savanna	Fayette
	Texas Post Oak Savanna Oakville Sandstone Outcrop	Grimes

USEPA Level III Ecoregion	Community	Distribution by County
South Central Plains	Eastern Gammagrass-(Switchgrass) Floodplain Herbaceous Vegetation	Austin, Delta, Franklin, Hopkins, Hunt, Smith, Titus, and Tyler
	East Texas Catahoula Barrens	Angelina, Jasper, Newton, and Tyler
	Morse Clay Calcareous Prairie	Bowie and Red River
	Upper West Gulf Coastal Plain Mesic Calcareous Woodland	Bowie
	Upper West Gulf Coastal Plain Xeric Sand Barrens	Cass and Marion
	Upper West Gulf Coastal Plain Xeric Sandhill Complex	Cass and Marion
	Weches Glade	Nacogdoches, Sabine, and San Augustine
	West Gulf Coastal Plain Clayey Longleaf Pine Woodland	San Jacinto and Walker
	West Gulf Coastal Plain Fleming Calcareous Prairie	Jasper, Newton, Polk, San Jacinto, Tyler, and Walker
	West Gulf Coastal Plain Salt Glade	Anderson, Harrison, and Panola
	West Gulf Coastal Plain Shallow Flatwoods Pond	Hardin, Jasper, and Newton
	West Gulf Coastal Plain Wet Longleaf Pine Savanna	Jasper and Newton
	West Gulf Coastal Plain Xeric Longleaf Pine Sandhill	Angelina, Jasper, Newton, Sabine, San Augustine, Shelby, and Tyler
	West Gulf Coastal Plain Xeric Upland Shortleaf Pine-Oak Woodland	Houston, Nacogdoches, Rusk, San Augustine, and Smith
	Western Upland Longleaf Pine Forest	Jasper, Hardin, Newton, and Orange
	Western Upland Longleaf Pine Forest	Hardin, Newton, and Tyler
	Western Wet Longleaf Pine Savanna	Hardin, Jasper, Newton, Orange, and Tyler

Source: (TPWD, 2016a)

ACRONYMS

Acronym	Definition
AGL	Above Ground Level
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	Act of 1979
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
B	Billion
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
BWI	Marshall International Airport
BYA	Billion Years Ago
CAA	Clean Air Act
CCMP	Comprehensive Conservation and Management Plan
CEQ	Council On Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH4	Dioxide (CO_2), Methane
CIAC	Community Involvement Advisory Council
CIMC	Cleanups In My Community
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLT	Cell On Light Trucks
COW	Cell On Wheels
CPCN	Certificate of Public Convenience and Necessity
CRS	Community Rating System
CWA	Clean Water Act
EFH	Essential Fish Habitats
EIA	Energy Information Agency
EMS	Emergency Medical Services
EOP	Emission Offset Provisions
EPCRA	Community Right To Know Act
FAA	Federal Aviation Administration
FAO	Food & Agriculture Organization
FAQ	Frequently Asked Questions
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FFC	Fossil Fuel Combustion
FGDC	Federal Geographic Data Committee
FHA	Federal Highway Administration

Acronym	Definition
FLM	Federal Land Manager
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GHG	Greenhouse Gas
GWDS	Ground Water Discharges Section
HAP	Hazardous Air Pollutant
HAP	Hazardous Air Pollutants
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
ILG	New Castle Airport
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LRR	Land Resource Regions
LTE	Long Term Evolution
LULUCF	Land Use Change, and Commercial Forestry
MBTA	Migratory Bird Treaty Act
MD/DE	Salisbury
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
MYA	Million Years Ago
N_2O	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
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERRS	National Estuarine Research Reserve System
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	of 1966, As Amended
NM	Nautical Miles
NOAA	National Ocean and Atmospheric Administration
NOTAM	Disseminated Via Notices To Airmen
NOX	Ozone
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List

Acronym	Definition
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NWI	National Wetlands Inventory
OCH_2CH_2	Ethylene Glycol, Diethylene Glycol, and Triethylene Glycol R
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OSHA	Occupational Safety and Health Act
OTR	Ozone Transport Region
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested Wetlands
PGA	Peak Ground Acceleration
PHL	Philadelphia International Airport
PLUS	Preliminary land use service
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSC	Public Service Commission
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Scrub-Shrub Wetlands
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
RFI	"Request For Information
RGGI	Regional Greenhouse Gas Initiative
SAA	Sense and Avoid
SAIPE	"Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SEPTA	Southeastern Pennsylvania Transportation Authority
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO2	PM2.5 (Direct Emissions)
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SSA	Sole Source Aquifer
SUA	Special Use Airspace
SWAP	State Wildlife Action Plan
SWPPP	Storm Water Pollution Prevention Plan

Acronym	Definition
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Services
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VMT	Vehicle Miles Traveled
VOC	Ozone
VR	Visual Route
WCS	Wetlands Classification Standard
WSLS	Wetlands and Subaqueous Lands Section
WWI	World War I
WWII	World War II

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