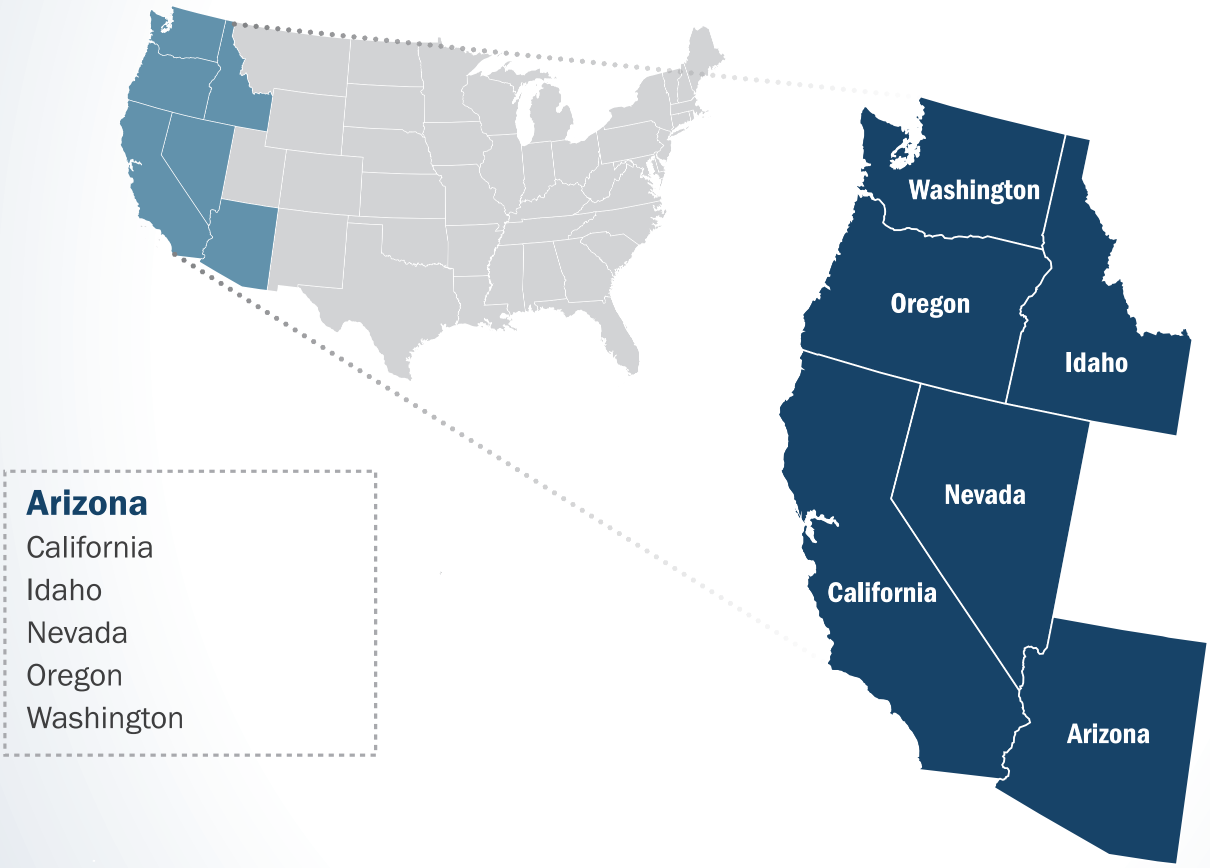
FirstNet®

Nationwide Public Safety Broadband Network
Draft Programmatic Environmental Impact Statement for the Western United States

VOLUME 1 - CHAPTER 3



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First Responder Network Authority

FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Western United States

VOLUME 1 - CHAPTER 3

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Cooperating Agencies
Federal Communications Commission
General Services Administration
U.S. Department of Agriculture—Rural Utilities Service
U.S. Department of Agriculture—U.S. Forest Service
U.S. Department of Agriculture—Natural Resource Conservation Service
U.S. Department of Defense—Department of the Air Force
U.S. Department of Energy
U.S. Department of Homeland Security

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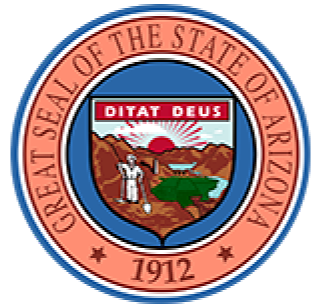
3. ARIZONA



American Indian Tribes with a rich cultural history lived in what is now the state of Arizona for centuries before the 1500s. A Spanish Franciscan priest named Marcos de Niza was one of the first Europeans to set foot in Arizona in 1539. The United States acquired Arizona from Mexico as part of the Gadsden Purchase in 1853, and pioneers started moving in. Arizona became the 48th state in 1912 (Office of the Arizona Governor, 2015). Arizona is bordered by California and Nevada to the west, Utah to the north, Mexico to the south, and New Mexico to the east. This chapter provides details about the existing environment of Arizona as it relates to the Proposed Action.

General facts about Arizona are provided below:

- **State Nickname:** The Grand Canyon State
- **Land Area (2010):** 113,594 square miles; **U.S. Rank:** 6 (U.S. Census Bureau, 2015a)
- **Capital:** Phoenix
- **Counties:** 15 (U.S. Census Bureau, 2015b)
- **Estimated Population (2015):** 6.8 million people; **U.S. Rank:** 14 (U.S. Census Bureau, 2015a)
- **Most Populated Cites:** Phoenix, Tucson, and Mesa (U.S. Census Bureau, 2012b)
- **Main Rivers:** Colorado River, Little Colorado River, Verde River, Salt River, and Gila River (NRCS, 2015b)
- **Bordering Waterbodies:** Colorado River
- **Mountain Ranges:** Chiricahua Mountains, Santa Rita Mountains, Santa Catalina Mountains, Huachuca Mountains, Patagonia Mountains, and Rincon Mountains (University of Arizona, 2016a)
- **Highest Point:** Humphreys Peak (12,633 ft) (USGS, 2015f)

3.1. AFFECTED ENVIRONMENT

3.1.1. Infrastructure

3.1.1.1. Definition of the Resource

This section provides information on key Arizona 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, 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 3.1.1.3 provides an overview of Arizona's traffic and transportation infrastructure, including road and rail networks and waterway facilities. Arizona's 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 the 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 Arizona are presented in more detail in Section 3.1.1.4 describes Arizona's public safety communications infrastructure and commercial telecommunications infrastructure. An overview of Arizona utilities, such as power, water, and sewer, is presented in Section 3.1.1.6.

3.1.1.2. Specific Regulatory Considerations

Multiple Arizona laws and regulations pertain to the state's public utility and transportation infrastructure and its public safety community. Table 3.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state's applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

Table 3.1.1-1: Relevant Arizona Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Arizona Revised Statutes: Title 26 Military Affairs and Emergency Management; Title 36 Public Health and Safety	Arizona Emergency Response Commission; Department of Emergency and Military Affairs	Develop and implement state hazardous materials emergency management program; prepares for and coordinates emergency management activities; and coordinates state, local, and federal government agencies during disaster events.

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

State Law/Regulation	Regulatory Agency	Applicability
Arizona Revised Statutes: Title 40 Public Utilities and Carriers	Arizona Corporation Commission (AZCC); Arizona Department of Transportation (AZDOT)	Supervise and regulate all public service corporations within the state.
Arizona Revised Statutes: Title 28 Transportation	AZCC; AZDOT; Transportation Board	Regulate railroads and rail carriers, exercise jurisdiction over state highways, routes, airports, and state-owned transportation systems

3.1.1.3. Transportation

This section describes the traffic and transportation infrastructure in Arizona, including specific information related to the road networks, airport facilities, and rail networks. The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to unpaved gravel or private roads. The information regarding existing transportation systems in Arizona are based on a review of maps, aerial photography, and federal and state data sources.

The Arizona Department of Transportation (AZDOT) has jurisdiction over freeways and major roads, airports, railroads, and mass transit in the state; local counties have jurisdiction for smaller streets and roads. The mission of the AZDOT is to "provide a safe, efficient, cost-effective transportation system" (AZDOT, 2015a).

Arizona has an extensive and complex transportation system across the entire state. The state's transportation network is comprised of:

- 66,441 miles of public roads (FHWA, 2014) and 8,035 bridges (FHWA, 2015a);
- Over 1,800 miles of rail network that includes passenger rail and freight (AZDOT, 2010);
- 307 aviation facilities, including airstrips and heliports (Sacramento County Airport System, 2015); and
- No major harbors or ports.

Road Networks

As identified in Figure 3.1.1-1, major urban centers of the state from northwest to southeast are Flagstaff, Prescott, Phoenix-Mesa-Scottsdale, Yuma, Tucson-Nogales, and Sierra Visa-Douglas (AZDOT, 2015b). Arizona has six 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 (AZDOT, 2014). Table 3.1.1-2 lists the interstates and their start/end points in Arizona. 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).

In addition to the Interstate System, Arizona has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 3.1.1-1 illustrates the major transportation networks, including roadways, in Arizona.

Section 3.1.8, Visual Resources, describes the National and State Scenic Byways found in Arizona from an aesthetic perspective.

Table 3.1.1-2: Arizona Interstates

Interstate	Southern or western terminus in Arizona	Northern or eastern terminus in Arizona
I-8	CA line at Yuma	I-10 in Casa Grande
I-10	CA line at Ehrenberg	NM line near San Simon
I-15	NV line near Scenic	UT line in Mohave County
I-17	I-10 in Phoenix	I-40 in Flagstaff
I-19	Mexico border at Nogales	I-10 in Tucson
I-40	CA line near Topock	NM line at Lupton

Source: (AZDOT, 2014)

National Scenic Byways are roads with nationwide interest; the byways are designated and managed by the U.S. Department of Transportation's Federal Highway Administration (FHWA). Arizona has five National Scenic Byways (FHWA 2015c):

- Coronado Trail Scenic Byway: 123 miles in eastern Arizona;
- Historic Route 66: 1,408.6 miles through Arizona, Illinois, New Mexico, and Oklahoma;
- Kaibab Plateau-North Rim Parkway: 42 miles in northern Arizona;
- Red Rock Scenic Byway: 7.5 miles in central Arizona; and
- Sky Island Scenic Byway: 27.2 miles in southern Arizona.

State Scenic Byways are roads with statewide interest. Some State Scenic Byways may be designated on portions of National Scenic Byways. Arizona has 21 State Scenic Byways, designated and managed by AZDOT (AZDOT, 2015c).[2]

- Desert to Tall Pines Scenic Road
- Dry Creek Scenic Road
- Jerome-Clarkdale-Cottonwood Historic Road
- Joshua Forest Scenic Road
- Mingus Mountain Scenic Road
- Swift Trail Parkway
- Diné Tah (Among the People) Scenic Road
- Fredonia-Vermillion Cliffs Scenic Road
- Kayenta-Monument Valley Scenic Road
- Naat'tsis'aan-Navajo Mountain Scenic Road
- San Francisco Peaks Scenic Road
- Sedona-Oak Creek Canyon Scenic Road
- Tse'nikani-Flat Mesa Rock Scenic Road
- White Mountain Scenic Road
- White River Scenic Road
- Apache Trail Historic Road
- Copper Corridor Scenic Road (SR 77)
- Copper Corridor Scenic Road (SR 177)
- Gila-Pinal Scenic Road
- Organ Pipe Cactus Parkway
- Patagonia-Sonoita Scenic Road

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

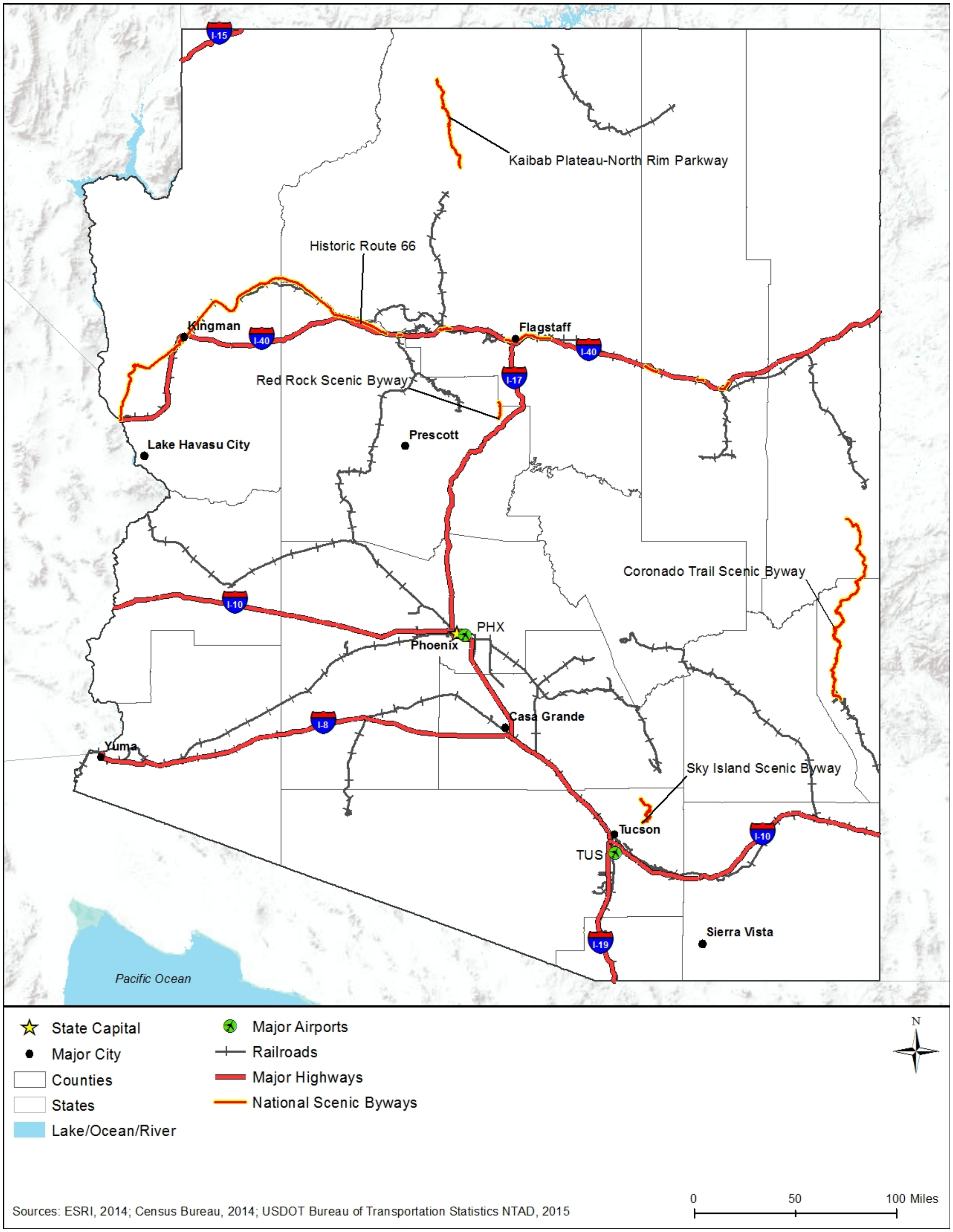


Figure 3.1.1-1: Arizona Transportation Networks

Airports

Air service to the state is provided by two international airports (Figure 3.1.1-1).

- Phoenix Sky Harbor International Airport (PHX) is owned and operated by the City of Phoenix (PHX 2015a). In 2015, the airport served 44,006,205 passengers and facilitated 440,411 aircraft operations (PHX 2015b). In that same year, the airport also handled 1,436,921,968 pounds of cargo, making it the 19th busiest airport in the nation in terms of cargo moved (FAA, 2015a).
- Tucson International Airport (TUS) is owned by the City of Tucson and operated by the Tucson Airport Authority (TUS 2015a). In fiscal year 2015, the airport served 3,181,901 passengers, facilitated 141,422 aircraft operations, and handled 66,184,562 pounds of freight and 28,526 pounds of mail (TUS 2015b).

Section 3.1.7.5, Airspace, provides greater detail on airports and airspace in Arizona.

Rail Networks

Arizona is connected to a network of passenger rail (Amtrak) and freight rail. Figure 3.1.1-1 illustrates the major transportation networks, including rail lines, in Arizona. Amtrak runs three lines through Arizona. The Southwest Chief runs every day between Chicago and Los Angeles; the Sunset Limited provides weekly service between New Orleans and Los Angeles; and the Texas Eagle travels between Chicago and Los Angeles three times a week. Amtrak stops at eight stations in Arizona; however, the lines that run through Arizona are overnight or long distance trains with limited daytime stops in Arizona. Table 3.1.1-3 provides a complete list of Amtrak lines that run through Arizona.

Table 3.1.1-3: Amtrak Train Routes Serving Arizona

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Arizona
Southwest Chief	Chicago, IL	Los Angeles, CA	40+ hours	Winslow, Flagstaff, Williams Junction, Kingman
Sunset Limited	New Orleans, LA	Los Angeles, CA	48 hours	Benson, Tucson, Maricopa, Yuma
Texas Eagle	Chicago, IL	Los Angeles, CA	65 hours 20 minutes	Benson, Tucson, Maricopa, Yuma

Source: (Amtrak, 2015)

Of the 1,800 miles of railroad track in Arizona, the freight rail company BNSF Railway owns 691 miles of track and Union Pacific owns 390 miles of track, for a total of 981 miles (AZDOT, 2010). Most of the freight rail cargo passes through Arizona. In 2005, 75 percent of freight rail traffic traveled through the state, without stopping in Arizona (AZDOT, 2011a). The majority of incoming rail traffic to Arizona originates in New Mexico (AZDOT, 2011a).

Harbors and Ports

Arizona is landlocked and has very few bodies of water. There are no harbors or ports in the state.

3.1.1.4. Public Safety Services

Arizona public safety services consist of public safety infrastructure and first responder personnel aligned with the population of the state. Table 3.1.1-4 presents Arizona's key demographics including population; land area; population density; and municipal governments. Information about demographics is presented in Section 3.1.9, Socioeconomics; however, these demographics are key to understanding the breadth of public safety services throughout the state.

Table 3.1.1-4: Key Arizona Indicators

Arizona Indicators	
Estimated Population (2015)	6,828,065
Land Area (square miles) (2010)	113,594.08
Population Density (persons per sq. mile) (2010)	56
Municipal Governments (2007)	90

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

Table 3.1.1-5 presents Arizona's public safety infrastructure, including fire and police stations. Table 3.1.1 6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and medical personnel in the state.

Table 3.1.1-5: Public Safety Infrastructure in Arizona by Type

Infrastructure Type	**Number**
Fire and Rescue Stations[a]	678
Law Enforcement Agencies[b]	141
Fire Departments[c]	249

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 state and local law enforcement agencies, which includes: 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 3.1.1-6: First Responder Personnel in Arizona by Type

First Responder Personnel	**Number**
Police, Fire and Ambulance Dispatchers[a]	1,740
Fire and Rescue Personnel[b]	10,837
Law Enforcement Personnel[c]	26,112
Emergency Medical Technicians and Paramedics[d, e]	3,720

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.

3.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Arizona; 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, 2016a).

Figure 3.1.1-2 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).

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.

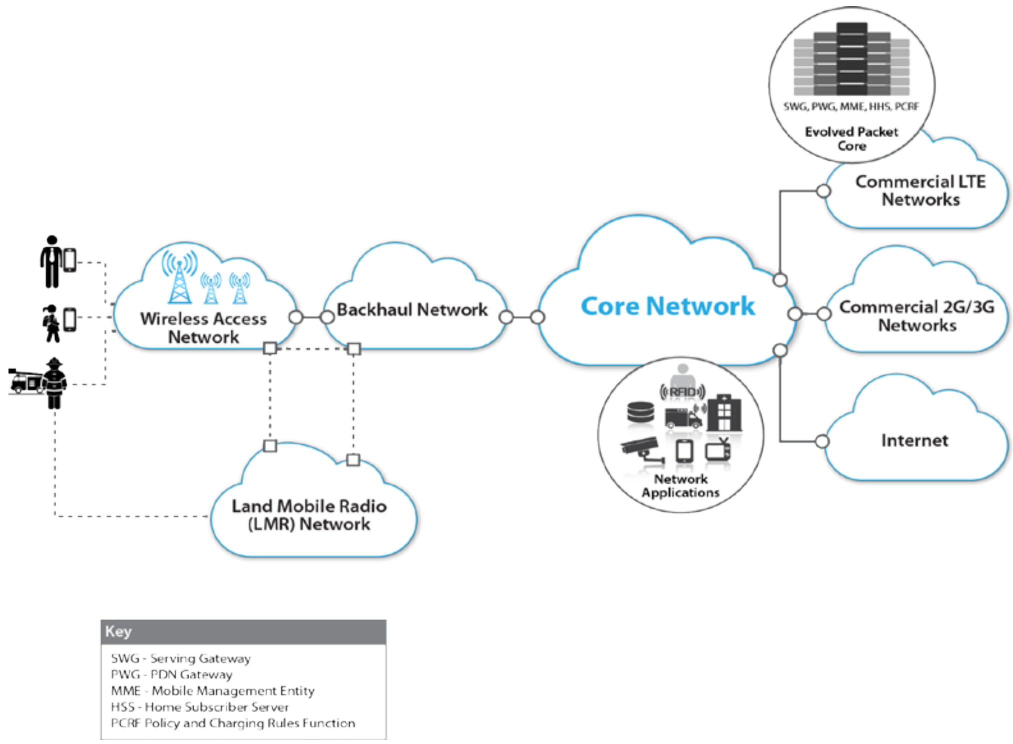


Figure 3.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

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 Arizona. 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, Arizona's public safety LMR network environment is facing transition and reflects the challenges of the need for greater system capabilities, as well as increased interoperability across Very High Frequency (VHF),[3] Ultra High Frequency (UHF)[4], 700 Mega Hertz (MHz), and 800 MHz systems. In addition, additional investments in tower site upgrades and coverage expansion as well as spending on digital P25 technologies has increased in the state. (NTIA, 2008)

The Arizona Interoperable Radio System (AIRS) Network is the primary system providing statewide interoperable communications. It also provides statewide mutual aid cross-banded capability (allowing communications across VHF, UHF, and 800 public safety LMR networks), as well as connectivity to Arizona's multiple regional public safety networks (AZDEMA, 2015a). Arizona's Department of Emergency Management and Military Affairs (AZDEMA) describes the mission of AIRS as follows, "AIRS is designed to provide interoperable communications capability to first responders of police, fire, and EMS agencies, as well as other personnel of municipal, county, state, tribal, federal agencies and approved non-governmental organizations (NGOs) performing public safety or public service activities" (AZDEMA, 2015a).

AZDEMA's Communications Branch has responsibility for coordinating and managing the state's emergency communications systems including LMR mobile radio systems.

Statewide/Multi-County Public Safety Networks

Statewide and multicounty interoperable communications is achieved in Arizona through the fifteen county AIRS network, as well as a number of multi-county regional networks such as the Yuma Regional Wireless System (YRWS) (RadioReference.com 2015a). As AZDEMA summarizes regarding the state's interoperability communications, "Interoperable radio communication channels are available to stakeholders through state wide and regional initiatives:

- Phoenix Regional Wireless System
- Yuma Regional Wireless System
- Arizona Interoperable Radio System
- Adherence to and acceptance of the National Interoperability Field Operations Guide
- Mesa Topaz System
- Tucson Pima County Wireless Integrated Network (PCWIN)
- Arizona AZDEMA Radio Network
- Mutual frequency sharing between jurisdictions" (AZDEMA, 2015b)

The statewide AIRS system is the successor to the Arizona legacy public safety system, Inter-Agency Radio System (IARS was initiated in the mid-1970s). IARS was formed to support communications needs between law enforcement agencies on VHF and UHF channels (RadioReference.com 2015b).

There are 14 Public Safety digital P25 networks operating in Arizona, including two tribal system and the cross-state Nevada/Arizona P25 Southern Nevada (SNACC) 800 MHz system

[3] VHF band covers frequencies ranging from 30 MHz to 300 MHz (NTIA, 2005).
[4] UHF band covers frequencies ranging from 300 MHz to 3000 MHz (NTIA, 2005).

(Project 25.org, 2015a) (Project 25.org, 2015b). Table 3.1.1-7 lists the P25 systems and identifies the operating frequencies for each network (Project 25.org, 2015a). 800 MHz systems have been the most common frequencies in use in these systems; however, 700 MHz systems are increasing in the state (RadioReference.com, 2016).

Table 3.1.1-7: Arizona P25 Networks

Arizona P25 Public Safety Systems	Frequency Band
Ak-Chin Indian Community	700 MHz
Arizona State University	800 MHz
Flagstaff Regional Public Safety (FRPS)	800 MHz
Marana Public Safety	800 MHz
Maricopa Public Safety	800 MHz
Regional Wireless Cooperative (RWC)	800 MHz
Southern California Edison (P25) System	900 MHz
Statewide Emergency Mobile System (SWEMS)	700 MHz
TOPAZ Regional Wireless Cooperative (TRWC)	700 MHz/800 MHz
Tucson Electric Power Company	800 MHz
Yuma Regional Communication System (YRCS)	700 MHz/800 MHz
Pima County Wireless Network (PCWIN)	800 MHz
Salt River Pima-Maricopa Indian Community	700 MHz
South NV (SNACC)-NV & AZ	800 MHz

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

Six of these P25 networks provide multi-county coverage in Arizona: AIRS (statewide), YRCS (14 counties), Maricopa (3 counties), RWC (3 counties), Southern California Edison (10 counties), TRWC (2 counties), and Tucson Electric Power Company (2 counties) (RadioReference.com, 2016).

For example, Arizona's P25 YRCS, provides broad regional coverage in 14 of Arizona's 15 counties as well as two counties in California (San Bernardino and Imperial). Formerly known as the Western Arizona Regional Interoperability Communications System, the YRCS network provides real-time simulcast capabilities to public safety users over 700 MHz and 800 MHz (RadioReference.com 2015d).

Arizona's P25 Regional Wireless Cooperative (RWC) system operates at 700 MHz and provides public safety communication services to three counties: Pima, Maricopa, and Yavapai (RadioReference.com 2015e).

Mesa Communications also operates a P25 statewide deployable trailer capability over 700 MHz which, when deployed, can cover a 5 to 10 mile area to support emergency communications needs for incidents and cross-agency mutual aid (RadioReference.com 2015f).

County/City Public Safety Networks

In Arizona, county and city public safety agencies are served by a significant number of P25 LMR networks in the state. In addition, county and city sheriff/police, fire, and EMS public safety users continue to depend upon analog legacy VHF and UHF networks for daily operations and tactical communications. (NTIA, 2008)

In Cochise County in southeastern Arizona, VHF and UHF systems dominate city and local LMR communications while the county sheriff's department (in addition to using the P25 YRCS 700 MHz/800MHz network) uses VHF frequencies for tactical communications. Public safety city and local agencies in Cochise County use a combination of VHF and UHF frequencies overwhelmingly, with VHF representing the largest percentage of systems covering the local public safety communications users (RadioReference.com, 2015c).

Commercial Telecommunications Infrastructure

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

Carriers, Coverage, and Subscribers

Arizona's commercial telecommunications industry provides the full spectrum of telecommunications technologies and networks, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems. Table 3.1.1-8 presents the number of providers of switched access[5] lines, Internet access,[6] and mobile wireless services including coverage.

Table 3.1.1-8: Telecommunications Access Providers and Coverage (2013)

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access line[a]	151	97.3% of households[b]
Internet access[c]	71	63% of households
Mobile wireless[d]	6	89% of population

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

[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.

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

Table 3.1.1-9 shows the wireless providers in Arizona along with their geographic coverage. The following four maps: Figure 3.1.1-3, Figure 3.1.1-4, Figure 3.1.1-5, and Figure 3.1.1-6 show the combined coverage for the top two providers, Sprint and T-Mobile's coverage; Commspeed AZ LLC, Transworld Network Corp, and Cricket Wireless' coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.

Table 3.1.1-9: Wireless Telecommunications Coverage by Providers

Wireless Telecommunications Providers	Coverage
Verizon Wireless	66.56%
AT&T Mobility LLC	56.18%
Sprint	23.72%
T-Mobile	15.19%
CommSpeed AZ LLC	11.31%
Transworld Network Corp	10.20%
Cricket Wireless	7.29%
Other[a]	8.96%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Ruralnet Wireless; Wydebeam Broadband; TruCom; Phoenix Internet; Simply Bits LLC; Transcend BB; AireBeam; Webhiway Communications; BeamSpeed LLC; Casa Grande Internet; CIS Wireless Broadband; Airband Communications Inc.; Bolt Internet; Coppernet Systems Inc.; Az AirNet; Valley Telecom Group; Xpressweb Internet Services Inc.; Arivaca; HPAZNET LLC; Desert iNET LLC; E-Sedonal; Rio Verde Wireless LLC; Grand Avenue Broadband; Pointe Wireless; Infowest Inc.; Last Mile Research LLC; Phoenix Sky Harbor International Airport.

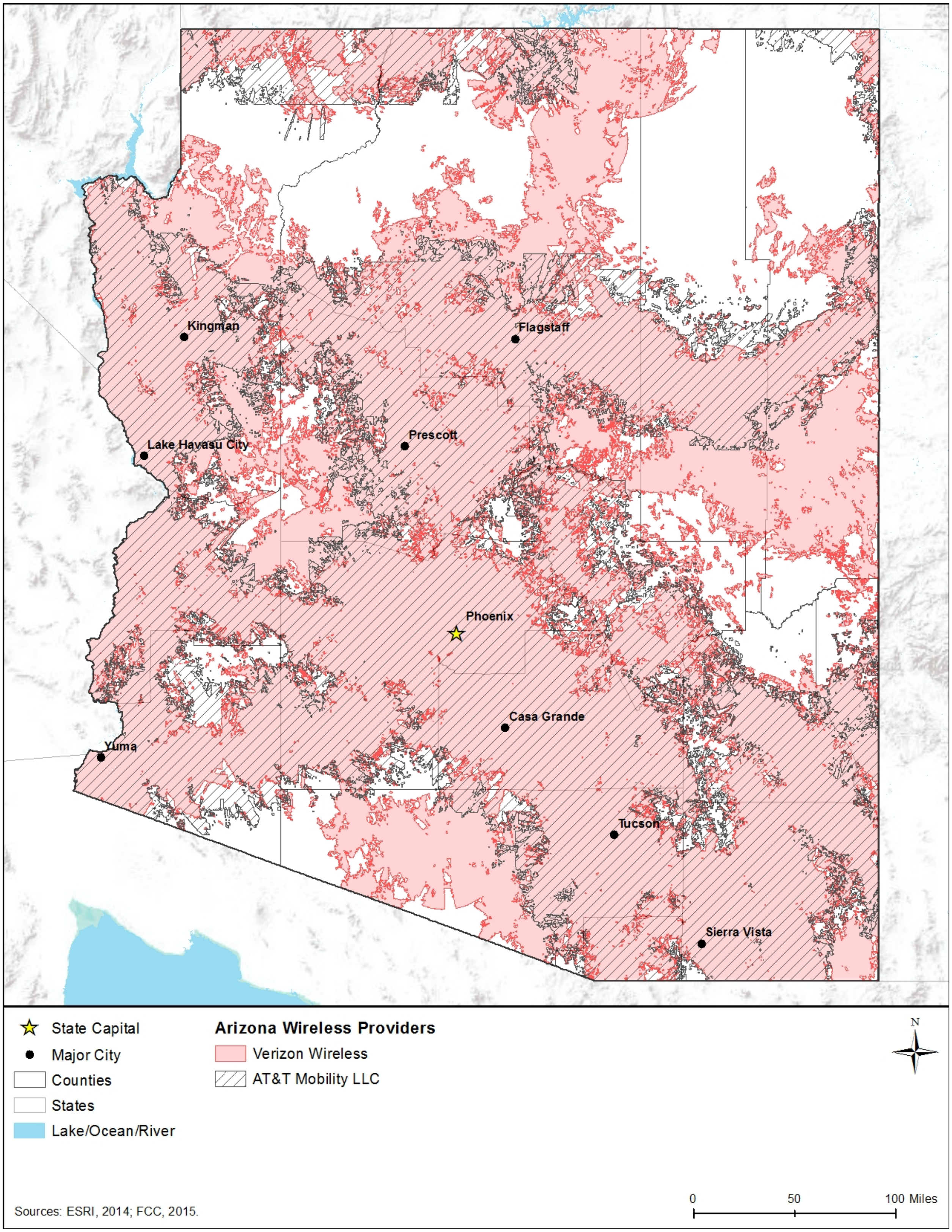


Figure 3.1.1-3: AT&T and Verizon Wireless Availability in Arizona

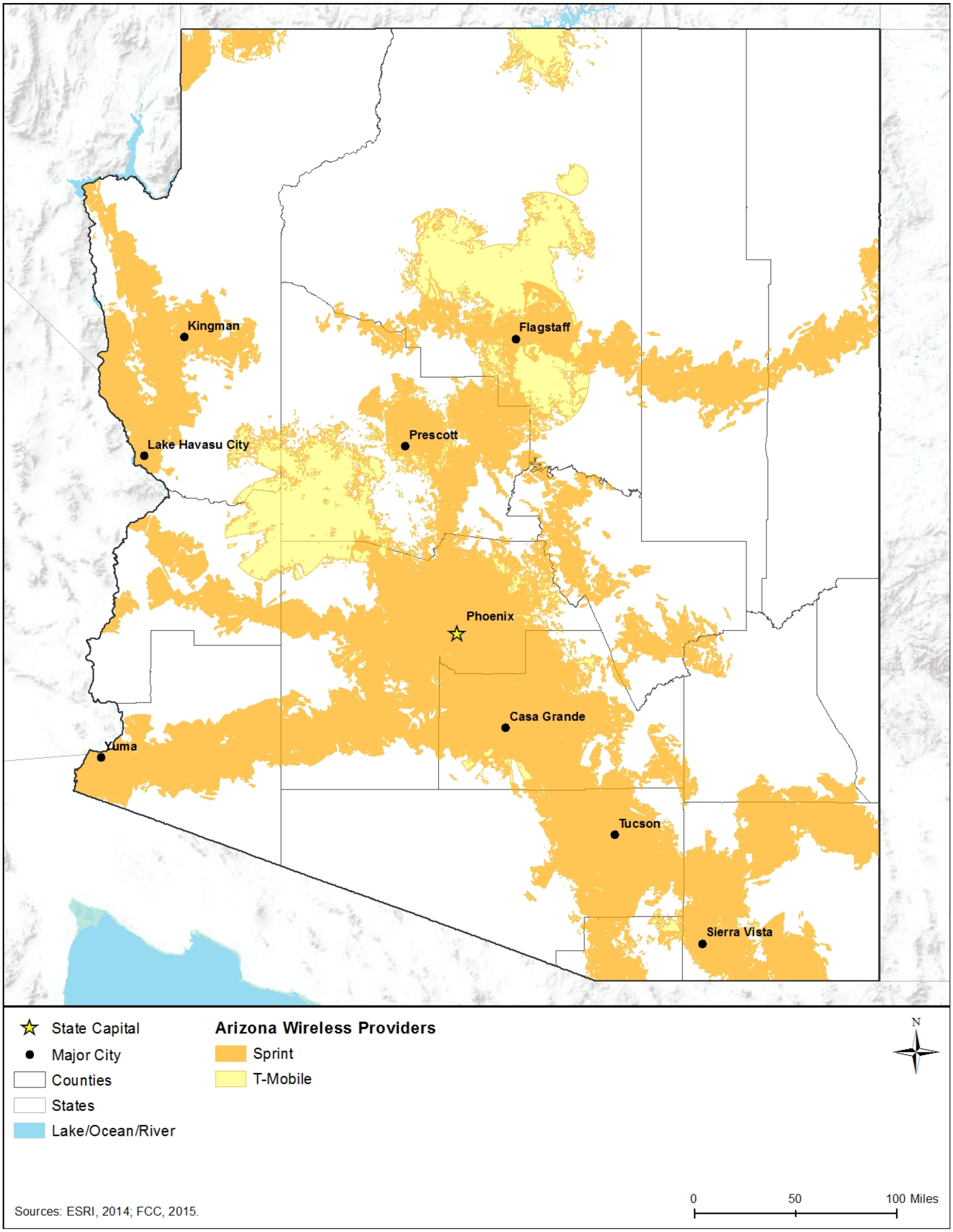


Figure 3.1.1-4: Sprint and T-Mobile Wireless Availability in Arizona

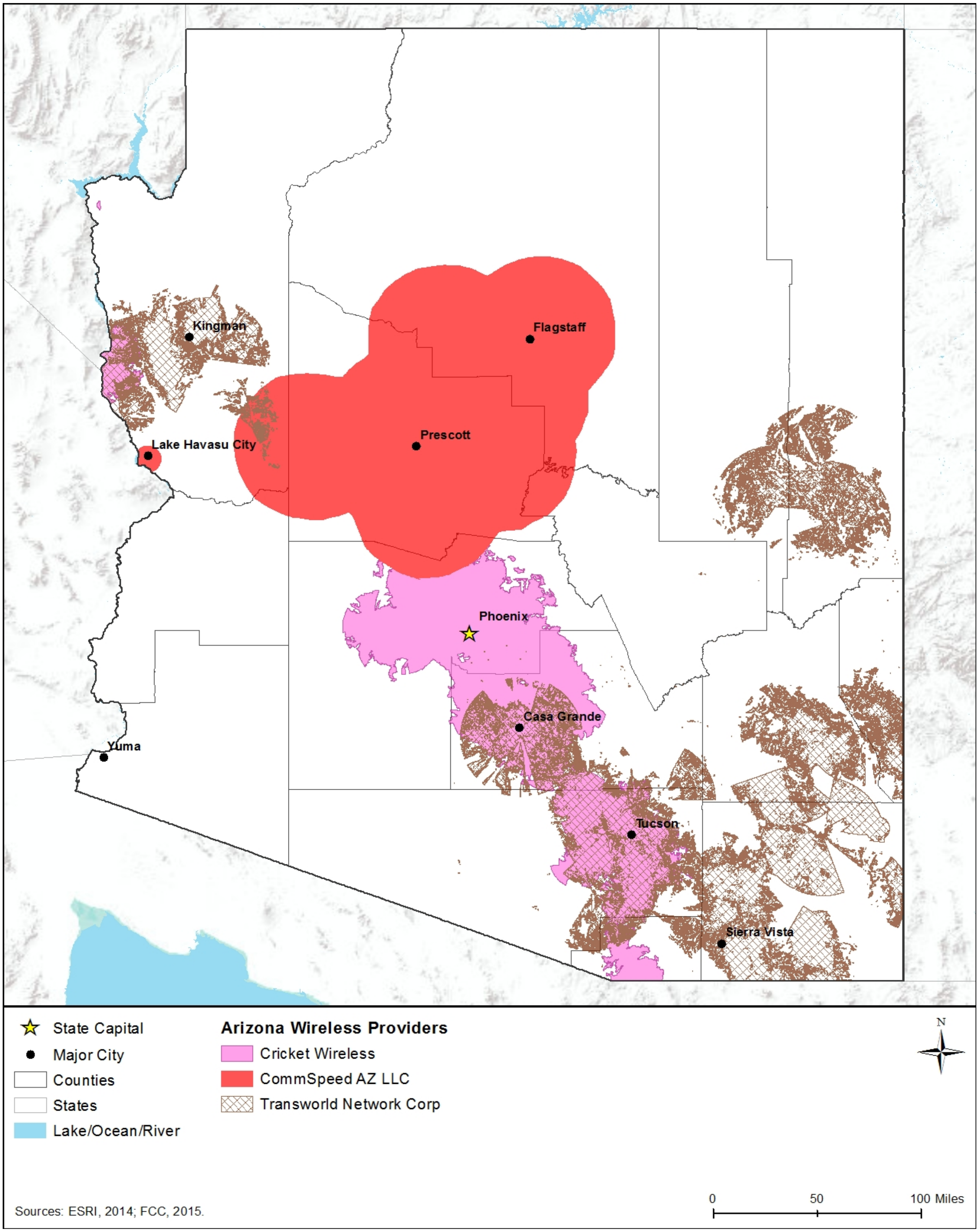


Figure 3.1.1-5: Cricket Wireless, CommSpeed AZ LLC, and Transworld Network Corp Wireless Availability in Arizona

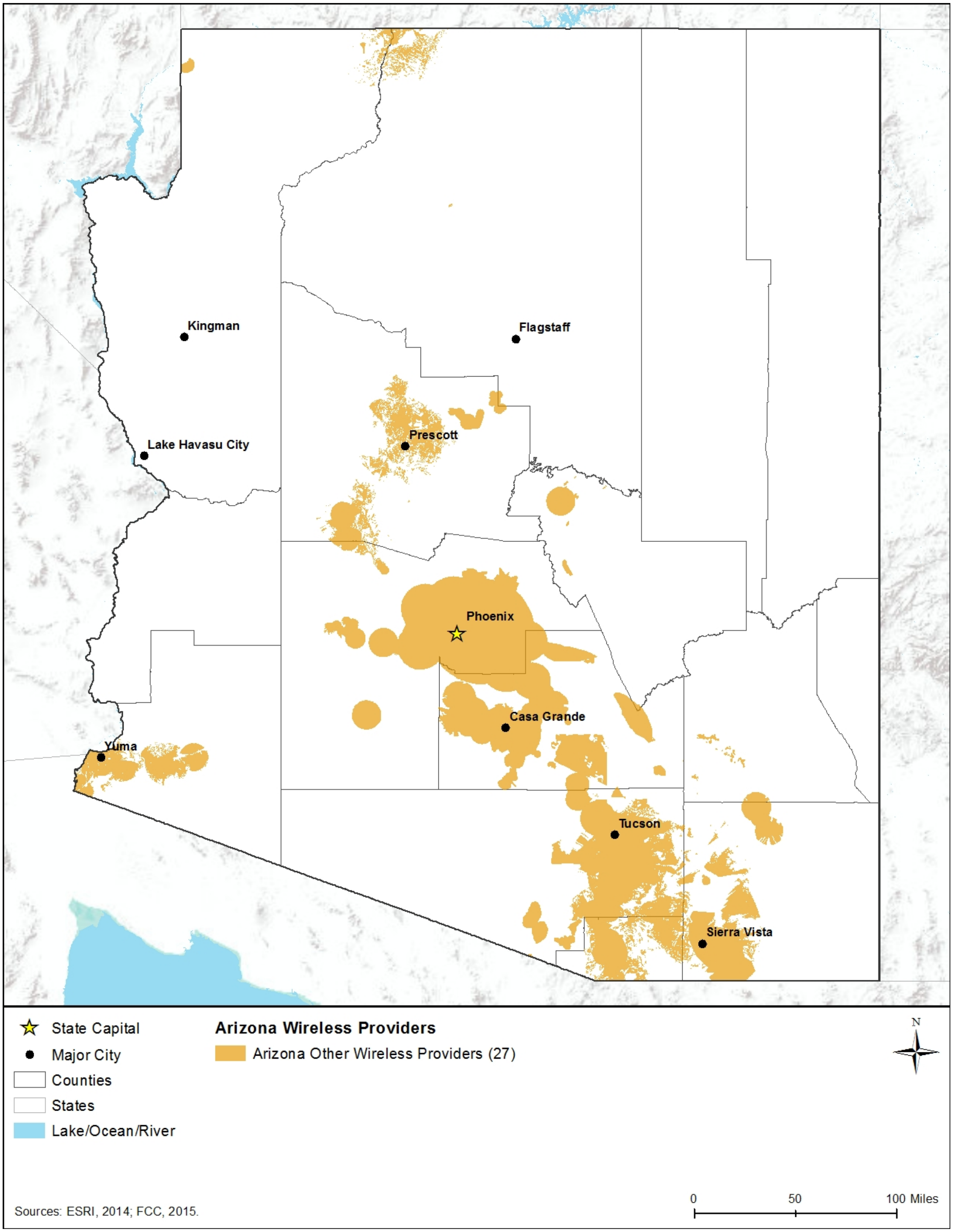


Figure 3.1.1-6: Other Providers Wireless Availability in Arizona

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 3.1.1-7 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 3.1.1-7: Types of Towers

Telecommunications tower infrastructure proliferates throughout Arizona, although tower infrastructure is concentrated in the higher and more densely populated areas of Arizona; Kingman, Lake Havasu City, Flagstaff, Prescott, Phoenix, Yuma, Casa Grande, Tucson, and Sierra Vista. Owners of towers and some types of antennas are required to register those infrastructure assets with the Federal Communications Commission (FCC) (FCC, 2016b).[7] Table 3.1.1-10 presents the number of towers (including broadcast towers) registered with the

[7] 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)

FCC in Arizona, by tower type, and Figure 3.1.1-10 presents the location of those structures, as of June 2016.

Table 3.1.1-10: Number of Commercial Towers in Arizona by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	32	100ft and over	0
75ft – 100ft	76	75ft – 100ft	0
50ft – 75ft	159	50ft – 75ft	3
25ft – 50ft	202	25ft – 50ft	29
25ft and below	262	25ft and below	93
Subtotal	**731**	**Subtotal**	**125**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	6	100ft and over	0
75ft – 100ft	4	75ft – 100ft	2
50ft – 75ft	10	50ft – 75ft	3
25ft – 50ft	1	25ft – 50ft	1
25ft and below	2	25ft and below	0
Subtotal	**23**	**Subtotal**	**6**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	5	100ft and over	0
75ft – 100ft	18	75ft – 100ft	0
50ft – 75ft	29	50ft – 75ft	1
25ft – 50ft	25	25ft – 50ft	0
25ft and below	19	25ft and below	0
Subtotal	**96**	**Subtotal**	**1**
Constructed Tanks[d]			
Tanks	6		
Subtotal	**6**		
Total All Tower Structures		**988**	

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).

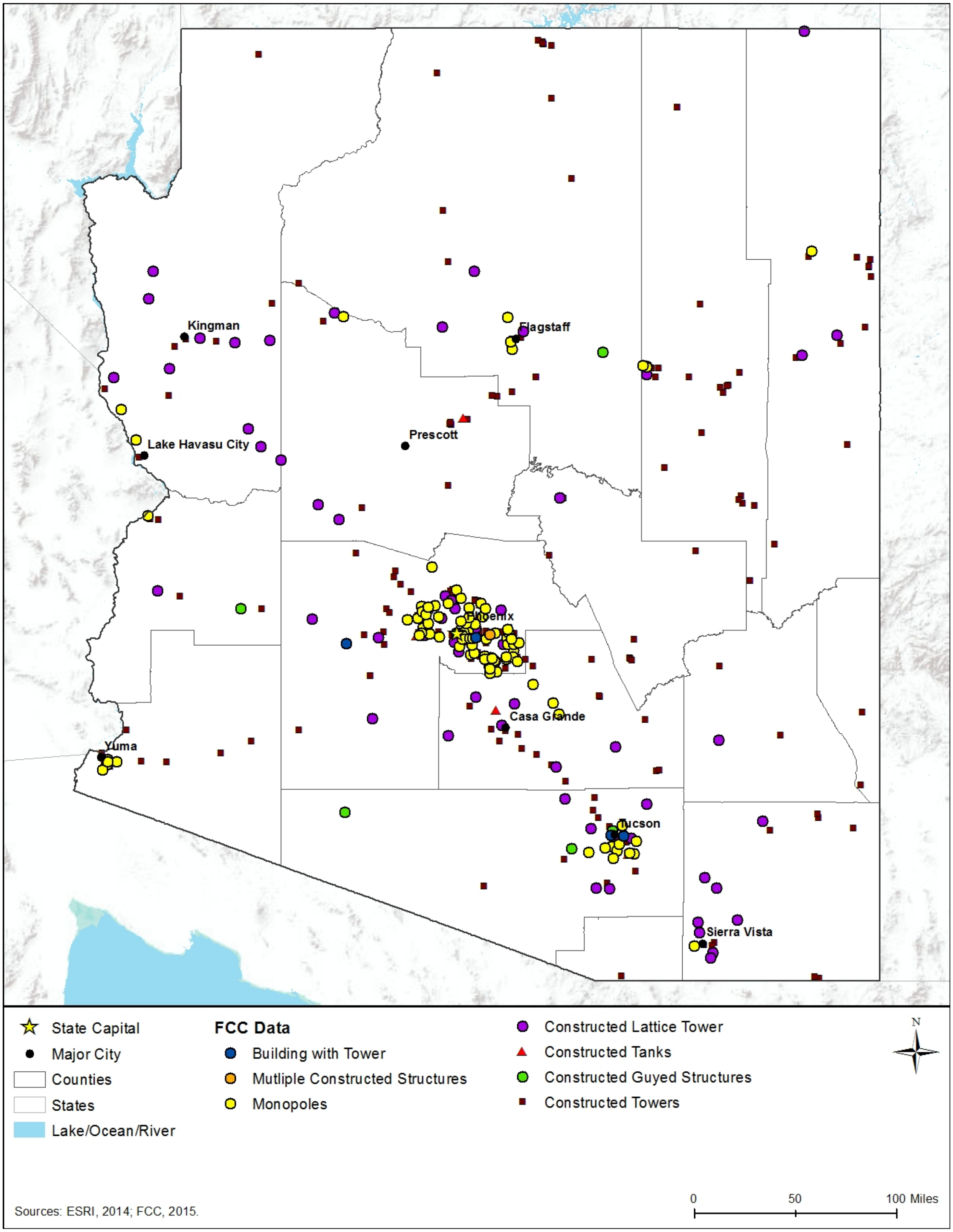


Figure 3.1.1-8: FCC Tower Structure Locations in Arizona

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 3.1.1-9. The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions) (FCC, 2000).

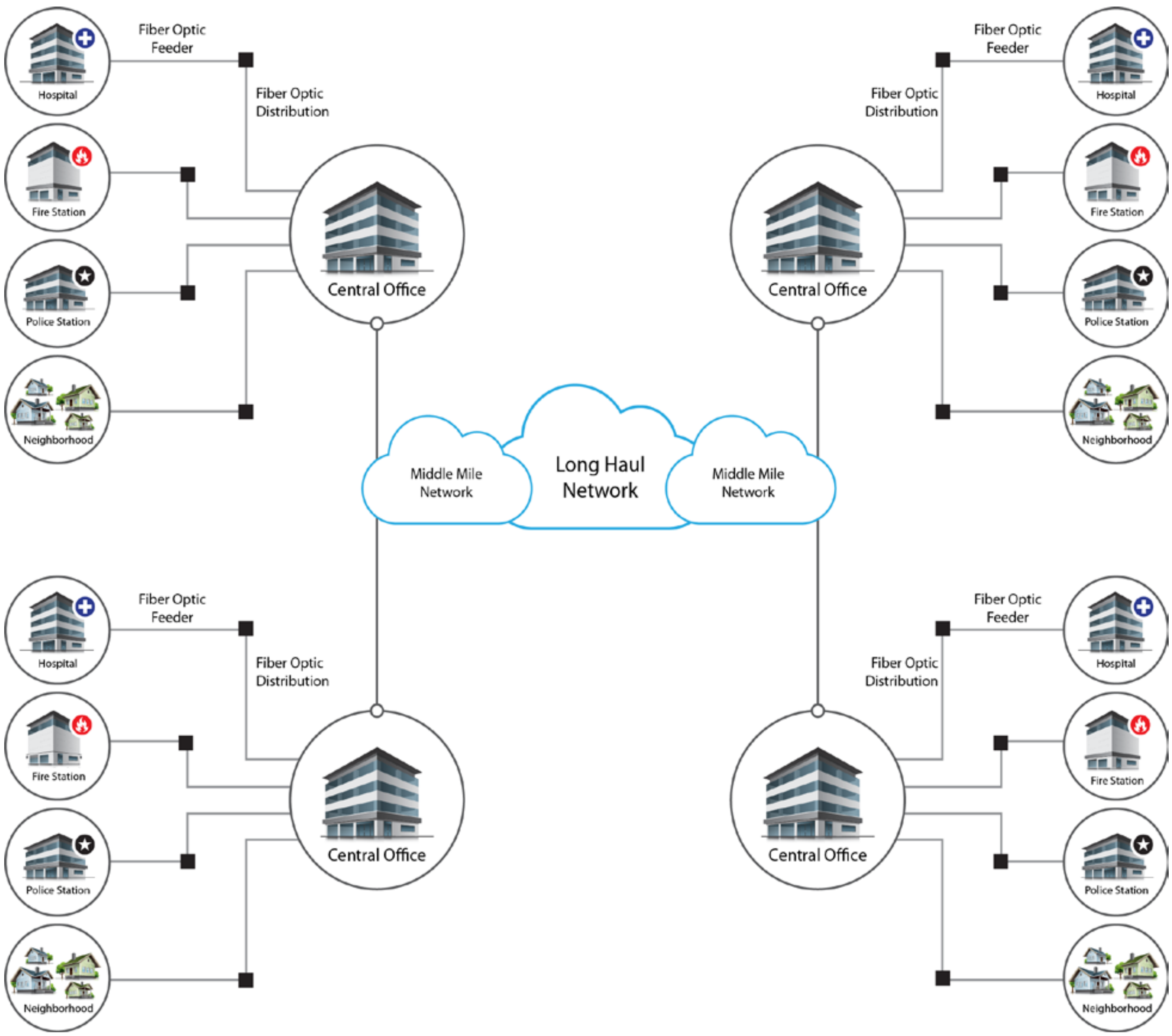


Figure 3.1.1-9: Typical Fiber Optic Network in Arizona

Prepared by: Booz Allen Hamilton

Source: (ITU-T 2012)

Last Mile Fiber Assets

In Arizona, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Arizona, there are 33 fiber providers that offer service in the state, as listed in Table 3.1.1-11 (NTIA, 2014). Figure 3.1.1-10 shows coverage for CenturyLink and Frontier Communications, Figure 3.1.1-11 shows coverage for MegaPath Corporation and Cox Communications Inc., and Figure 3.1.1-12 shows coverage for all other providers with less than 5 percent coverage area, respectively.[8]

Table 3.1.1-11: Fiber Provider Coverage

Fiber Provider	Coverage
CenturyLink	2.84%
Frontier Communications	2.45%
MegaPath Corporation	1.49%
Cox Communications Inc.	1.32%
Other[a]	3.16%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5 percent coverage area. Providers include: Integra Telecom; Table Top Telephone Company; Valley Telecom Group; Cable One; Suddenlink Communications; Comcast; Mediacom Southeast; Time Warner Cable; Level3 Communications LLC; MTE Communications; TDS Telecom; TW Telecom of Arizona LLC; Triplet Mountain Communications Inc.; XO Communications LLC; Tohono O'odham Utility Authority; Zona Communications; Zayo Enterprise Networks LLC; Fort Mojave Telecommunications Inc.; Saddleback Communications; Rio Virgin Telephone Company; Hopi Telecommunications Inc.; Orbitel Communications LLC; Salt River Project; Western Broadband LLC; South Central Utah Telephone Association Inc.; Golden Valley Cable and Communications Inc.; Ygnition Networks Inc.; Cogent Communications; Greenfield Communications Inc.

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

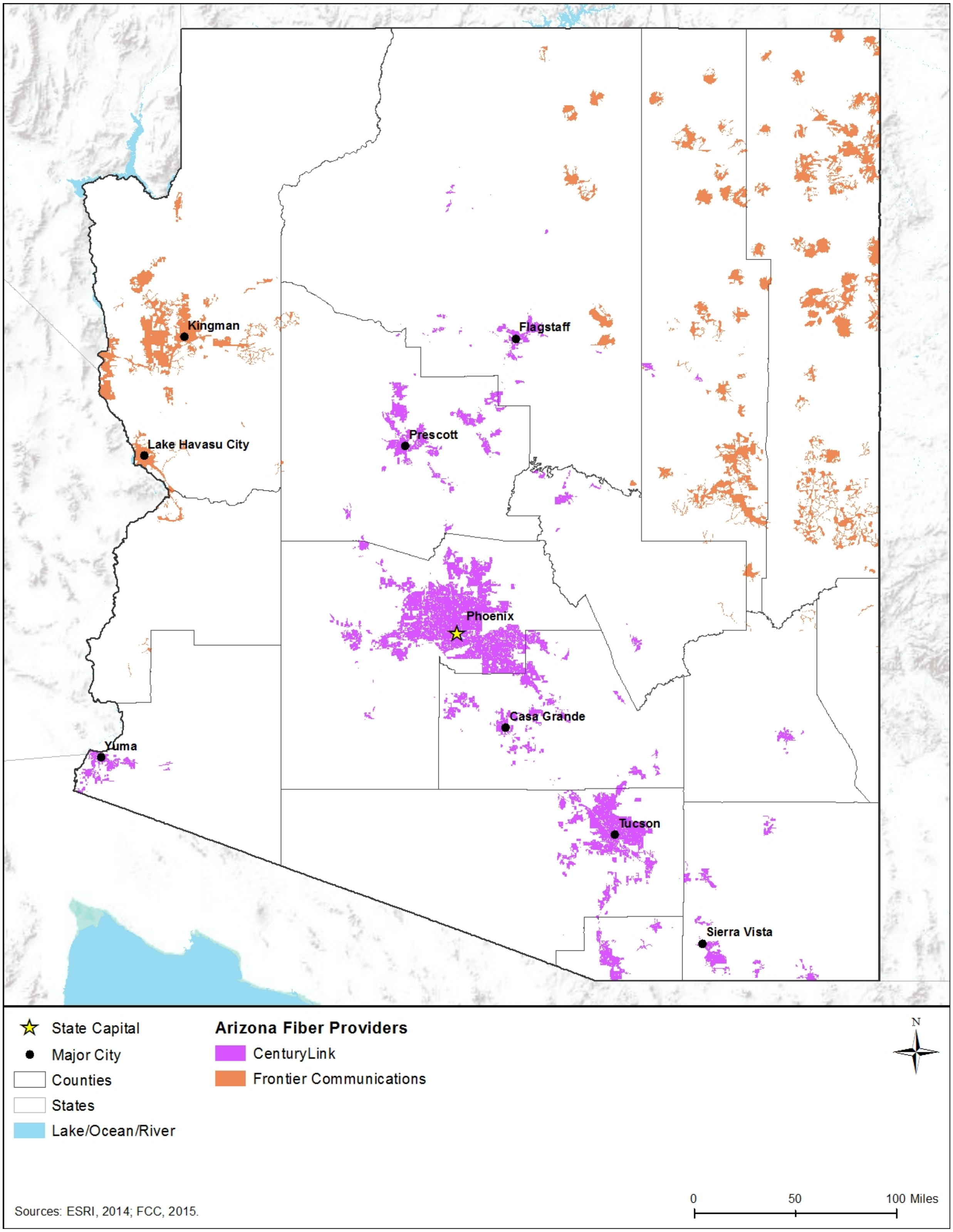


Figure 3.1.1-10: Fiber Availability in Arizona for CenturyLink and Frontier Communications

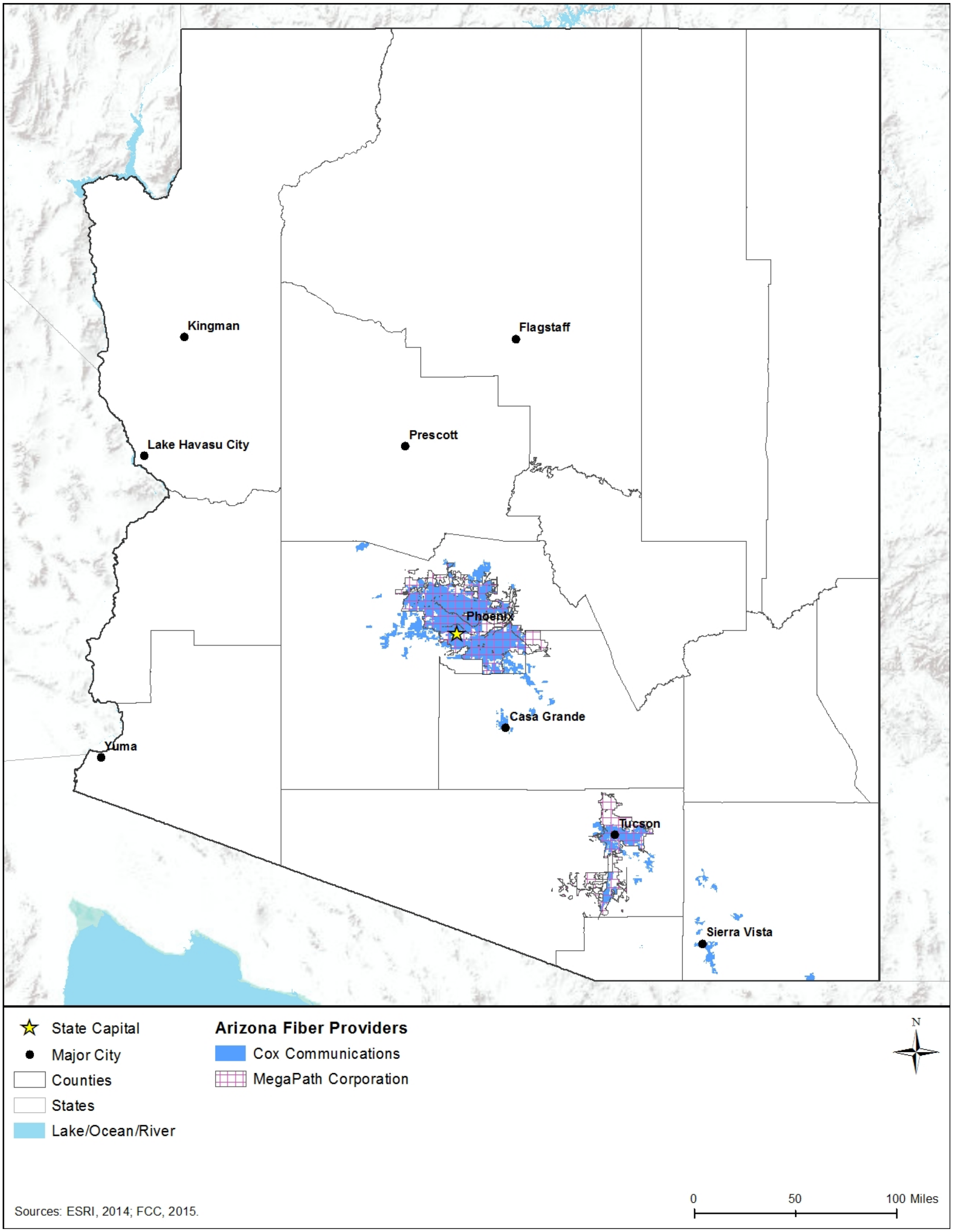


Figure 3.1.1-11: Cox Communications Inc.'s and MegaPath's Fiber Availability in Arizona

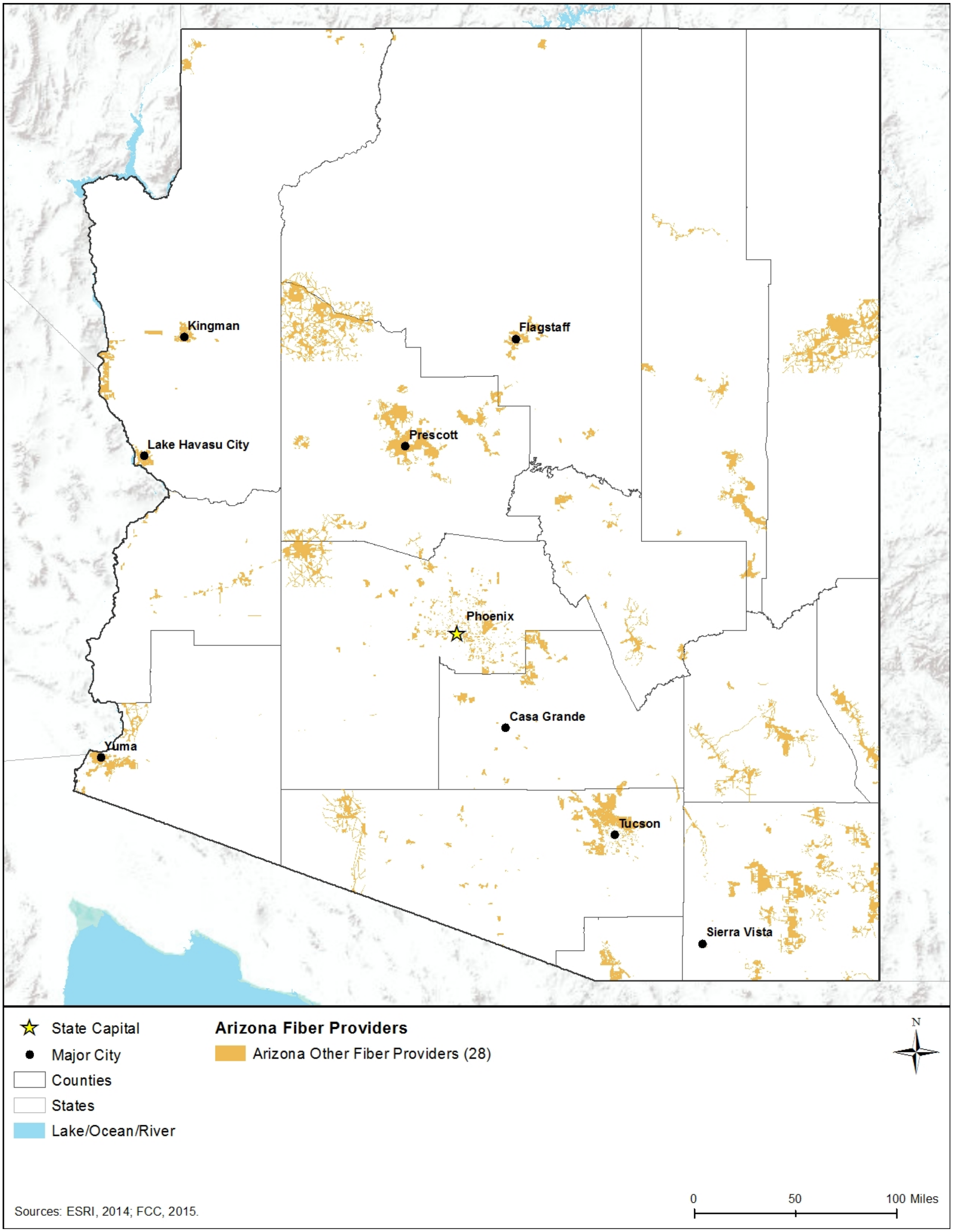


Figure 3.1.1-12: Other Provider's Fiber Availability in Arizona

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.

3.1.1.6. 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 3.1.4, Water Resources, describes the potable water sources in the state.

Electricity

Electricity utilities in Arizona are overseen by the Arizona Corporation Commission (AZCC). Among other duties, the AZCC regulates both the rates and service quality provided by public utilities. Much of this responsibility falls to the Utilities Division of the AZCC, which makes recommendations to “assist them [electric utilities] in reaching decisions regarding public utility rates, utility finance and quality of service” (AZCC, 2015a). The AZCC regulates fifteen electricity utilities, of which nine are cooperatives serving a given geographic area, such as Graham County Electric Cooperative (AZCC, 2015b). Arizona’s three largest sources of electricity are generation plants powered by coal, natural gas or nuclear power (EIA, 2015a). In 2015, these three sources accounted for 90 percent of electricity generated (EIA, 2015a). The largest of these was coal, generating 31,915,610 megawatthours[9] (50 percent) of the total 62,774,297 megawatt-hours produced that year. Nuclear power and natural gas contributed 32 percent and 4 percent, respectively. Hydroelectric plants produced 12 percent, with wind power, biomass and petroleum liquids contributing minimal amounts (EIA, 2015a). Arizona boasts the largest nuclear power plant in the United States. In 2014, “Arizona ranked second in the nation in utility-scale electricity generation from solar energy” (EIA, 2015g). A goal set by the Arizona Renewable Environmental Standard aims to have 15 percent of electricity consumed in 2025 come from a renewable source. Arizona’s industrial sector only accounted for 15 percent of the total energy consumption in 2013. By comparison, in 2013, the transportation sector used 32.4 percent, the residential sector used 28.1 percent, and the commercial sector used 24.5 percent. (EIA, 2015g)

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

Water

Some aspects of water utilities in Arizona are regulated by the AZCC. The Utilities Division of the AZCC helps to regulate the rates and service quality for utilities in under their jurisdiction (AZCC, 2015a). For water utilities, this jurisdiction extends to cover the 400 water systems in Arizona operated by a private company. These 400 systems are operated by about 350 companies, some of which oversee several systems (AZCC, 2015c). Water utilities are issued a Certificate of Convenience and Necessity (CC&N) granting them a geographic range for which to provide service (AZCC, 2015d). Drinking water quality standards are set by the federal Safe Drinking Water Act (SDWA), though the United States Environmental Protection Agency (USEPA) allows states to build on and enforce these regulations. Among other regulations, water systems are required to test for more than 80 contaminants that appear in drinking water and report the findings to the state (ADEQ, 2015a). In Arizona, this responsibility falls to the Arizona Department of Environmental Quality (ADEQ). Two of the largest counties in the state are allowed enact SDWA regulations in lieu of the ADEQ through their own programs: the Maricopa Country Drinking Water Program and the Pima County Health Department. The ADEQ oversees water elsewhere in the state, with the exception of federal facilities and tribal lands (ADEQ, 2015b). Both tribal lands and federal facilities are regulated by the USEPA. The ADEQ and the counties of Maricopa and Pima oversee some 1,550 public water systems across the state. Public water systems are defined as “any water system that has 15 or more service connections (hook-ups) or serves 25 or more people” (ADEQ, 2015c). Systems that do not fit the previous description are usually considered private water systems and are not overseen by the ADEQ. Monitoring the quality of water in private wells and other private systems is the responsibility of the system’s owner (ADEQ, 2015c).

Wastewater

Arizona’s public wastewater utilities have certain aspects of their operation regulated by the AZCC, including their rates and quality of service (AZCC, 2015a). There are 21 sewer companies that fall under the regulatory authority of the AZCC, as well as an additional 20 companies that provide both water and sewer services. Some companies own and operate multiple systems (AZCC, 2015c). The regulation of wastewater discharge is the responsibility of the ADEQ and its Water Quality Division. They establish standards to manage issues of pollution and issue permits to wastewater dischargers to control possible pollution sources (ADEQ, 2015d). Permits are distributed by the Groundwater Section and the Surface Water Section of the Water Quality Division. “These permits protect groundwater and surface water quality by controlling discharges from domestic wastewater treatment plants, mining operations, industrial facilities, on-site sewage disposal systems, direct reuse of reclaimed water and stormwater discharges associated with industrial activity as well as discharges to drywells” (ADEQ, 2015e). One of the most important permits for wastewater dischargers is the Arizona Pollutant Discharge Elimination System Permit (AZPDES), as this permit is required by facilities discharging into navigable waterways (ADEQ, 2015f). The ADEQ also requires facility operators to be certified by the state (though it does accept certifications from other states). These certifications are organized into grades by "facility type, size, complexity, and population served" (ADEQ, 2015g).

Solid Waste Management

The management of Arizona's solid waste is overseen by the ADEQ. Among other actions, the ADEQ issues permits for the operation of waste management facilities, handles inspections of these facilities, and advocates for reduction and recycling of waste. Landfills for municipal and non-municipal waste, transfer stations, designated American Indian landfills, biohazardous waste facilities, and waste tire collection sites all fall under the regulation of the ADEQ (ADEQ, 2015h). As of 2014, the state was home to 69 landfills, represented by a mixture of municipal, American Indian, and private facilities with a total landfilled quantity of 7,579,831 tons of solid waste (ADEQ, 2015i). Additionally, in 2016, there are 270 closed solid waste facilities in the state (ADEQ, 2016a). In 2014, Arizona municipalities recycled 229,000 tons of materials, such as paper, glass, metal, and plastic. A total of 446,429 tons came from comingled recyclables (meaning individual types like paper or glass are not separated during collections) were also collected (ADEQ, 2015j).

3.1.2. Soils

3.1.2.1. 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.

3.1.2.2. 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 3.1.2-1 below.

Table 3.1.2-1: Relevant Arizona Soil Laws and Regulations

State Law/Regulation	Agency	Applicability
Arizona Pollutant Discharge Elimination System (AZPDES) Program	ADEQ	Construction sites that disturb one or more acre of surface soil are required to have erosion and sediment controls in place.

Source: (ADEQ, 2013b)

3.1.2.3. Environmental Setting

Arizona is composed of one Land Resource Region (LRR),[10] as defined by the Natural Resources Conservation Service (NRCS), the Western Range and Irrigated Region (NRCS, 2006). Within and among Arizona's one LRR, are seven Major Land Resource Areas (MLRA)[11], which are characterized by patterns of soils, climate, water resources, land uses, and type of farming. The locations and characteristics of Arizona's MLRAs are presented in Figure 3.1.2-1 and Table 3.1.2-2.

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[12] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[13] 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[14] (discussed further in the subsections below).

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[10] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[11] 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).
[12] The flora and fauna of a region.
[13] Expansive soils are characterized by the presence of "swelling clay materials" that absorb water molecules when wet and expand in size or shrink when dry leaving "voids in the soil" (Rogers, Olshansky, & Rogers, 2004).
[14] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength strength (USFS, 2009b).

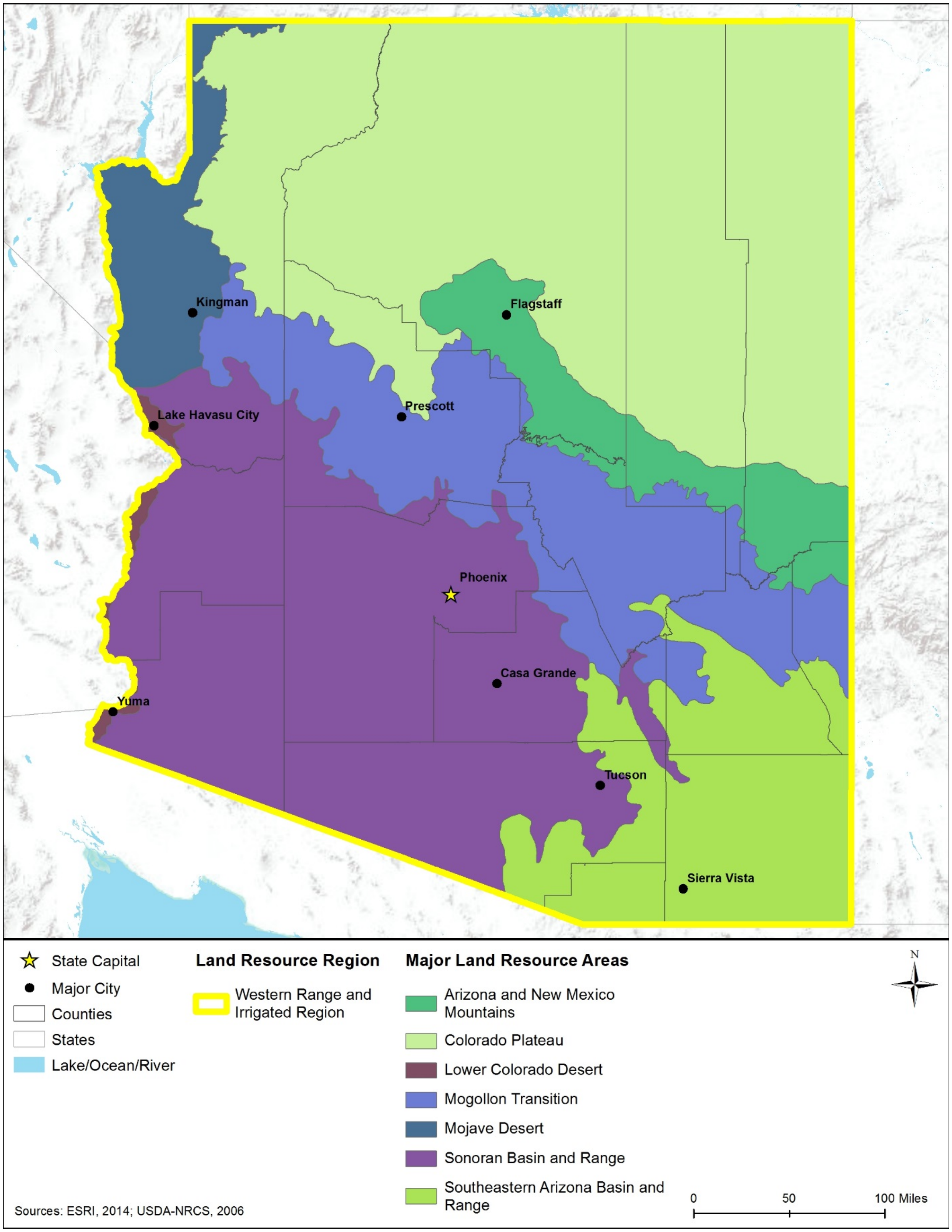

Figure 3.1.2-1: Locations of Major Land Resource Areas in Arizona

Table 3.1.2-2: Characteristics of Major Land Resource Areas in Arizona

MLRA Name	Region of State	Soil Characteristics
Arizona and New Mexico Mountains	Central Arizona	Alfisols,[a] Entisols,[b] Inceptisols,[c] and Mollisols[d] are the dominant soil orders.
Colorado Plateau	Northern Arizona	Alfisols, Aridisols,[e] Entisols, and Mollisols are the dominant soil orders. These loamy[f] or clayey soils are typically well drained or somewhat excessively drained; range from very shallow to deep.
Lower Colorado Desert	Southwestern Arizona	Aridisols and Entisols are the dominant soil orders. These very deep soils range from coarse to fine textured, and are well drained to excessively drained.
Mogollon Transition	Central Arizona	Alfisols, Aridisols, and Mollisols are the dominant soil orders. These well drained to somewhat excessively drained soils range from very shallow to very deep.
Mojave Desert	Northwestern Arizona	Aridisols and Entisols are the dominant soil orders. These soils range from shallow to very deep, and are well drained or excessively drained. They are loamy-skeletal or sandy-skeletal.
Sonoran Basin and Range	Southwestern Arizona	Aridisols and Entisols are the dominant soil orders. Well drained to somewhat excessively drained soils ranging very shallow to very deep.
Southeastern Arizona Basin and Range	Southeastern Arizona	Alfisols, Aridisols, Entisols, and Mollisols are the dominant soil orders. These well drained to somewhat excessively drained soils range from very shallow 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 percent of the world's ice-free land surface." (NRCS, 2015c)

[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 percent of the world's ice-free land surface." (NRCS, 2015c)

[c] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17 percent of the world's ice-free land surface." (NRCS, 2015c)

[d] 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, 2015c)

[e] 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 percent of the world's ice-free land surface." (NRCS, 2015c)

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

3.1.2.4. 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 with 12 soil orders in the world characterized by both observed and inferred[15] properties (i.e., texture, color, temperature, and moisture regime). Soil suborders are the next level, and differentiate within an order by moisture and temperature regimes, as well as physical and chemical properties (NRCS, 2015d). The STATSGO2[16] soil database identifies 18 soil suborders in Arizona (NRCS, 2015e). Figure 3.1.2-2 depicts the distribution of the soil suborders; Table 3.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[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)."

[16] STATSGO2 is the Digital General Soil Map 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.

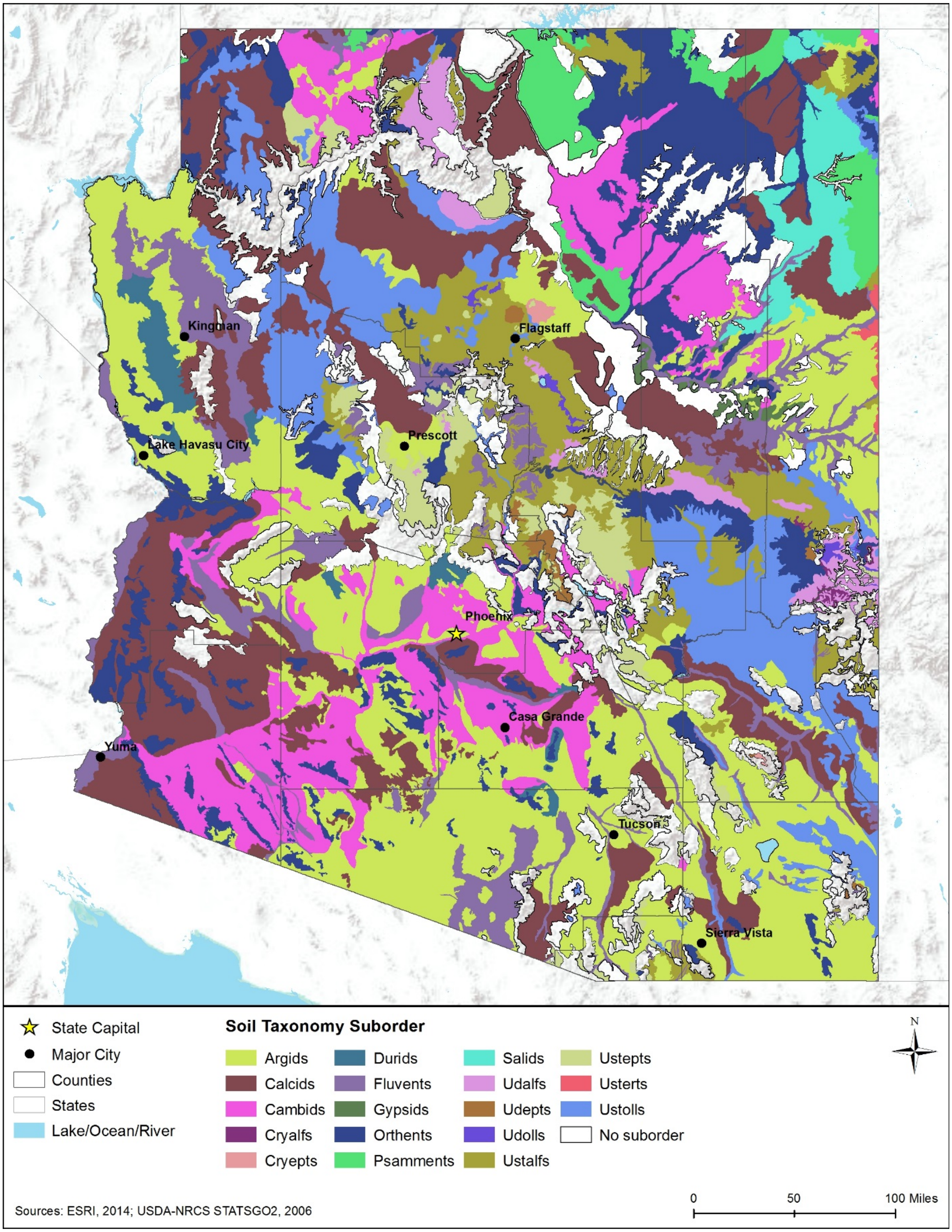

Figure 3.1.2-2: Arizona Soil Taxonomy Suborders

Table 3.1.2-3: Major Characteristics of Soil Suborders[a] Found in Arizona, as depicted in Figure 3.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (Percent)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
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.	Clay, Clay loam, Extremely cobbly sandy clay, Extremely gravelly loam, Extremely gravelly loamy sand, Extremely gravelly sandy clay loam, Fine sandy loam, Gravelly clay, Gravelly clay loam, Gravelly loam, Gravelly sandy clay loam, Gravelly sandy loam, Indurated, Loam, Sandy clay loam, Sandy loam Silty clay loam, Unweathered bedrock, Very fine sandy loam, Very gravelly loam, Very gravelly sandy clay loam	0-60	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, 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, Coarse sandy loam, Extremely gravelly loam, Extremely gravelly sandy clay loam, Extremely gravelly sandy loam, Fine sand, Fine sandy loam, Gravelly fine sandy loam, Gravelly loam, Gravelly sandy loam, Indurated, Loam, Loamy fine sand, Sand, Sandy loam, Unweathered bedrock, Very channery loam, Very cobbly loam, Very fine sandy loam, Very gravelly coarse sandy loam, Very gravelly loam, Very gravelly sandy loam	0-50	Moderately well 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
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.	Extremely gravelly loamy sand, Fine sandy loam, Gravelly sandy loam, Loam, Loamy fine sand, Sandy clay loam, Sandy loam, Unweathered bedrock, Very gravelly sandy clay loam, Very gravelly sandy loam	0-50	Well drained to somewhat excessively drained	No	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	Low
Aridisols	Cryalfs	Cryalfs are cold weather soils found primarily at high elevations. Due to the cold, short growing season, the majority of these soils are utilized as forest.	Cobbly loam, Sandy clay loam	15-40	Well drained	No	B	Medium	Moderate	Medium	Low
Inceptisols	Cryepts	Cryepts are soils of high latitudes or high elevations, and support cold weather vegetation such as conifers and hardwoods. They are mostly used as forest or wildlife habitat, although some are also used as cropland.	Loam, Very gravelly sandy loam	15-40	Somewhat excessively drained	No	C	Medium	Low	Medium	Low
Aridisols	Durids	Durids are found in the western United States, with the majority found in Nevada and Idaho. A few areas are used as irrigated cropland, but most are utilized as wildlife habitat or rangeland. They are characterized by a soil subsurface horizon cemented by silica (duripan).	Extremely gravelly sandy loam, Indurated, Very gravelly loam, Very gravelly sandy loam	0-30	Well drained to somewhat excessively drained	No	D	High	Very Low	High	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (Percent)	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, Clay loam, Gravelly fine sandy loam, Loam, Sandy clay loam, Silt loam, Stratified gravelly sandy loam to silt loam, Very fine sandy loam, Very gravelly sand, Very gravelly sandy clay loam, Very gravelly sandy loam	0-9	Poorly drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, 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.	Weathered bedrock	1-8	Well drained	NA[d]	D	High	Very Low	High	NA[c]
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Clay loam, Cobbly fine sandy loam, Extremely cobbly sand, Extremely gravelly loam, Extremely gravelly sandy loam, Fine sandy loam, Gravelly clay loam, Gravelly loam, Gravelly sand, Loam, Loamy very fine sand, Sandy clay loam, Sandy loam, Silty clay loam, Unweathered bedrock, Variable, Very cobbly loam, Very gravelly clay loam, Very gravelly fine sandy loam, Very gravelly loam, Very gravelly loamy sand, Very gravelly sandy loam, Weathered bedrock	0-80	Well drained to excessively drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low 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, Fine sandy loam, Loamy fine sand, Loamy sand	0-25	Well drained to excessively drained	No	A	Low	High	Low	Low
Aridisols	Salids	Salids are primarily found in Nevada and Utah, and commonly located in depressions (playas). They have a saline horizon that makes them unsuitable for agricultural use unless they are leached of salts. Therefore, most of these soils are utilized for wildlife habitat or rangeland.	Clay, Clay loam	0-12	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.	Cobbly loam, Extremely stony clay, Stratified very cobbly fine sandy loam, Unweathered bedrock, Very cobbly sandy clay loam, Very gravelly clay loam, Very gravelly loam	0-40	Well drained	No	B	Medium	Moderate	Medium	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (Percent)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential	Permeability[c]	Erosion Potential	Compaction and Rutting Potential
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the northwest and mixed or hardwood forest in the east. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Sandy loam, Very gravelly sandy loam	15-60	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Mollisols	Udolls	Udolls are found in humid climates. They are more or less freely drained, and have historically supported tall grass prairie. They are used as pasture or rangeland, and as cropland in areas with little slope.	Clay loam, Silt loam, Very gravelly loam	0-9	Well drained	No	C, D	Medium, High	Low, Very Low	Medium 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, Cobbly clay, Cobbly clay loam, Cobbly sandy clay, Cobbly sandy clay loam, Extremely gravelly sandy loam, Fine sandy loam, Gravelly loam, Gravelly sandy clay, Loam, Sandy clay loam, Unweathered bedrock, Very cobbly clay loam, Very gravelly sandy clay loam, Very gravelly sandy loam	0-60	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Inceptisols	Ustepts	Ustepts are freely drained soils, typically used as pasture or cropland, although some support forest, rangeland, and wildlife habitat.	Cobbly clay, Cobbly loam, Extremely gravelly loam, Gravelly loam, Loam, Sandy loam, Silty clay loam, Very flaggy sandy loam, Very gravelly loam, Very gravelly sandy loam, Very stony fine sandy loam	0-65	Well drained to somewhat excessively 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.	Silty clay, Silty clay loam	0-3	Well drained	No, Yes	D	High	Very Low	High	High, due to hydric soil
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.	Clay, Clay loam, Cobbly clay loam, Cobbly loam, Extremely cobbly loam, Gravelly clay loam, Gravelly loam, Sandy clay loam, Stratified very fine sandy loam to clay loam, Stratified very gravelly sand to very gravelly clay, Unweathered bedrock, Very cobbly cinders, Very cobbly clay loam, Very cobbly fine sandy loam, Very cobbly loam, Very gravelly clay loam, Very gravelly fine sandy loam, Very gravelly loam, Very gravelly loamy sand, Very gravelly sandy clay loam, Very stony clay loam	0-75	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low

Sources: (NRCS, 2015e) (NRCS, 1999)
[a] Soil suborders constitute a broad range of soil types. Within each suborder, the range of soil types may have a range of properties across the state, which result in multiple values being displayed in the table for that suborder.
[b] Hydric Soil: "A soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (NRCS, 2015c). 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 3.1.2.5.
[d] This information was not available from NRCS data.

3.1.2.5. 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 3.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Arizona.

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). Calcids, Orthents, and Psamments fall into this category in Arizona.

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. Argids, Calcids, Cambids, Cryalfs, Fluvents, Orthents, Udalfs, Udepts, Ustalfs, Ustepts, and Ustolls fall into this category in Arizona.

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. Argids, Calcids, Cryepts, Fluvents, Orthents, Udepts, Udolls, Ustalfs, Ustepts, and Ustolls fall into this category in Arizona.

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). Argids, Calcids, Cambids, Durids, Fluvents, Gypsids, Orthents, Salids, Udolls, Ustalfs, Ustepts, Usterts, and Ustolls fall into this category in Arizona.

3.1.2.6. 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

[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).

into streams, rivers, and lakes, degrading water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (NRCS, 1996a). Table 3.1.2-3 (above) provides a summary of the erosion potential for each soil suborder in Arizona. Soils with erosion potential in Arizona include those in the Argids, Calcids, Cambids, Cryalfs, Cryepts, Durids, Fluvents, Gypsids, Orthents, Salids, Udalfs, Udepts, Udolls, Ustalfs, Ustepts, Usterts, and Ustolls suborders, which are found throughout most of the state (Figure 3.1.2-2).

3.1.2.7. Soil Compaction and Rutting

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

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 3.1.2-3 (above) provides a summary of the compaction and rutting potential for each soil suborder in Arizona. Soils with the highest potential for compaction and rutting in Arizona include those in the Usterts suborder, which are primarily in northeastern areas of the state (Figure 3.1.2-2).

3.1.3. Geology

3.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and groundwater availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 3.1.4), Human Health and Safety (Section 3.1.15), and Climate Change (Section 3.1.14).

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

- Section 3.1.3.3, Environmental Setting: Physiographic Regions and Provinces[19,20]
- Section 3.1.3.4, Surface Geology
- Section 3.1.3.5, Bedrock Geology[21]
- Section 3.1.3.6, Paleontological Resources[22]
- Section 3.1.3.7, Fossil Fuel and Mineral Resources
- Section 3.1.3.8, Geologic Hazards[23]

3.1.3.2. 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 3.1.3-1.

Table 3.1.3-1: Relevant Arizona Geology Laws and Regulations

State Law/Regulation	Agency	Applicability
Arizona Antiquities Act (AAA), Arizona Revised Statutes (ARS) §41-841, et seq.; and, Arizona Board of Regents (ABOR) rules 8-201 through 8-207 as authorized by ARS §15-1631	Arizona State Museum	A permit is required to perform any paleontological surveying, monitoring, testing, or excavation on municipal, county, or state lands. This permit applies to individuals, corporations, organizations, or institutions.
Arizona Building Codes	Local Agencies	Check county, city, and other local agencies for seismic guidelines in building codes. Examples include Phoenix and Tucson.

3.1.3.3. Environmental Setting: Physiographic Regions and Provinces

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

Arizona is entirely within the Intermontane Plateau Physiographic Region (Basin and Range and Colorado Plateaus Physiographic Provinces) (Figure 3.1.3-1) (Fenneman, 1916).

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

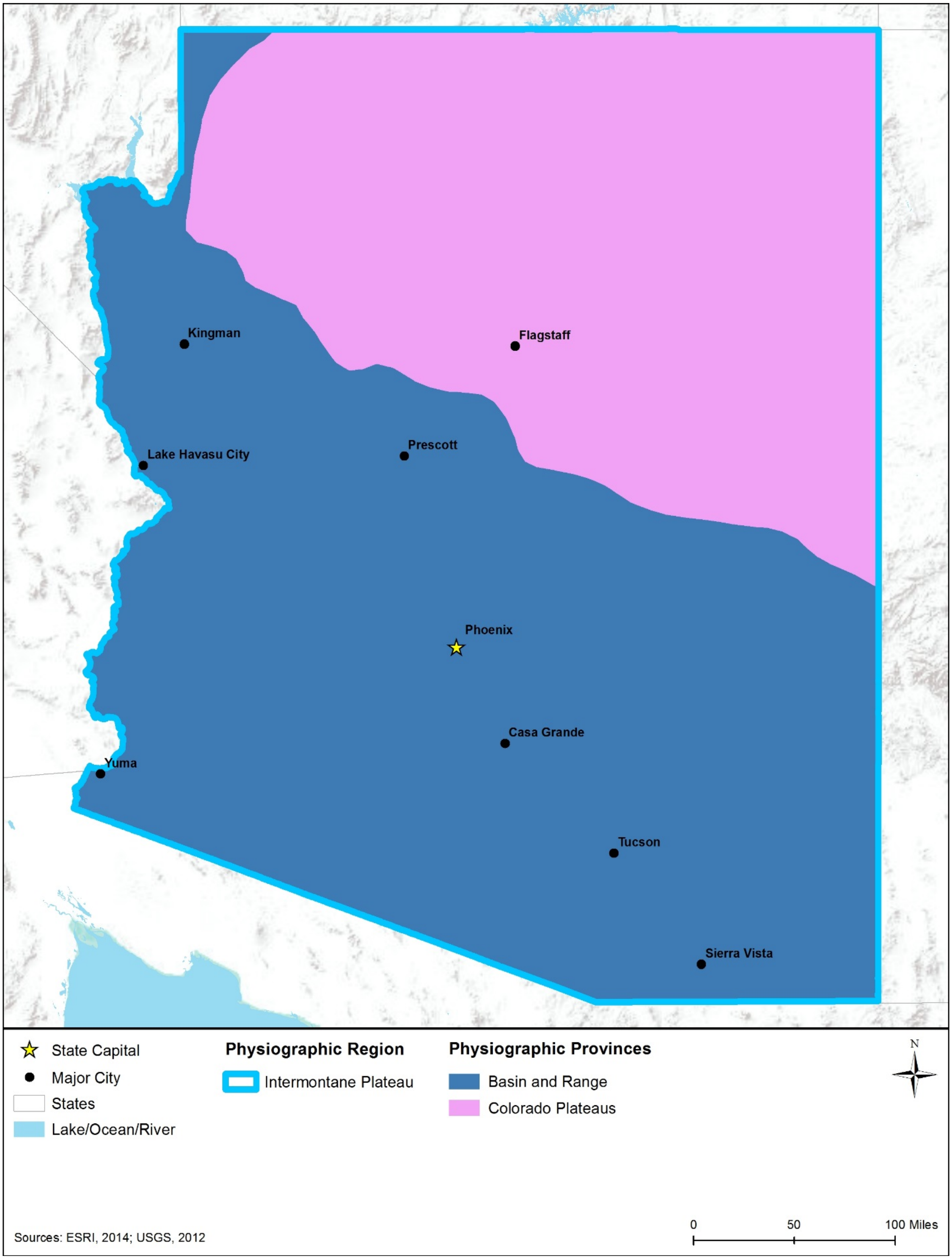

Figure 3.1.3-1: Physiographic Regions and Provinces of Arizona

Intermontane Plateau Region

The Intermontane Plateau Region describes the area between the Rocky Mountains and the Sierra Nevada and Cascade Ranges. 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).[24] The region is characterized by interspersed higher-elevation plateaus and mountains, and lower-lying basins. Within Arizona, the Colorado Plateaus is the major elevated area, while the Basin and Range geologic province includes the region's lowest elevations. (Lew, 2004)

Basin and Range Province

The Basin and Range Province is characterized by north-south trending mountains and valleys that were created as the landscape in the region underwent extension[25] over the past 30 million years (NPS, 2014a). This tectonic activity has thinned the Earth's crust and created large faults that have resulted in the "distinctive alternating pattern of linear mountain ranges and valleys" (USGS, 2014a). Within Arizona, the Basin and Range includes the southern two-thirds of the state, as well as western portions of the state. The province is noted for its abundance of normal faults;[26] elevations throughout the Basin and Range in Arizona vary between 300 feet above sea level (ASL) and more than 10,000 feet ASL (College of Agriculture, University of Arizona, 1985). As topography became elevated, mountains eroded and buried the valley floor beneath the eroded sediments (USGS, 2014a). These topographic features were created roughly between 13 and 6 MYA (College of Agriculture, University of Arizona, 1985).

Colorado Plateaus Province

The Colorado Plateaus Province includes much of northern and northeastern Arizona (USGS, 1995a). This province is characterized by "a thick sequence of largely undeformed, nearly flat-lying sedimentary rocks" interspersed by dramatic rock formations attributable to erosion (Milligan, 2000). These rocks span hundreds of millions of years across both the Paleozoic and Mesozoic Eras (USGS, 2014b). The Colorado Plateaus Province was uplifted more than a mile starting 20 MYA resulting in erosion through the latter portions of the Cenozoic Era and continuing today. "As the land rose, the streams responded by cutting ever deeper stream channels," producing the region's characteristic canyons (USGS, 2014b). The Grand Canyon is the region's most noteworthy topographic feature in Arizona, with 40 unique sedimentary rock layers exposed that span the entire Paleozoic Era (542 to 251 MYA) (NPS, 2015a). Precambrian

[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] Extension: "In geology, the process of stretching the Earth's crust. Usually cracks (faults) form, and some blocks sink, forming sedimentary basins." (USGS, 2015e)
[26] Normal Fault: "A fault that drops rock on one side of the fault down relative to the other side." (USGS, 2015e)

(older than 542 MYA) metamorphic[27] rocks, including gneiss[28] and schist[29] dating to 1.8 billion years ago, form the bottom of the canyon. Topographic relief throughout the Grand Canyon reaches about 8,000 feet between its highest and lowest points (NPS, 2015a).

3.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[30] 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,[31] subsidence,[32] and erosion. (Thompson, 2015)

Arizona was not covered by ice sheets during the Pleistocene Ice Age. However, alpine glaciers within the state's higher elevations existed between 2 MYA and 15,000 years ago. Streams emanating in Arizona's mountain glaciers "transported and deposited more sediment (sand, gravel, silt, and clay) in their channels and on floodplains." These alluvial[33] sediments cover basin areas throughout southern and western Arizona (AZGS, 2005). In particular, the Sonoran Desert (in southern Arizona) contains basins that are surrounded by low to mid-elevation mountain ranges. Many areas of eroded sands and gravels have formed alluvial fans[34] at the base of these mountains (Northern Arizona University, 1999). Figure 3.1.3-2 depicts a generalized illustration of the surface geology for Arizona.

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[27] 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, 2015e)

[28] Gneiss: "A coarse-grained, foliated metamorphic rock that commonly has alternating bands of light and dark-colored minerals." (USGS, 2015e)

[29] Schist: "Metamorphic rock usually derived from fine-grained sedimentary rock such as shale. Individual minerals in schist have grown during metamorphism so that they are easily visible to the naked eye." (USGS, 2015e)

[30] 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)

[31] 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)

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

[33] Alluvium: "Sand, gravel, and silt deposited by rivers and streams in a valley bottom." (USGS, 2015e)

[34] Alluvial Fan: "A fan-shaped pile of sediment that forms where a rapidly flowing mountain stream enters a relatively flat valley. As water slows down, it deposits sediment (alluvium) that gradually builds a fan." (USGS, 2015e)

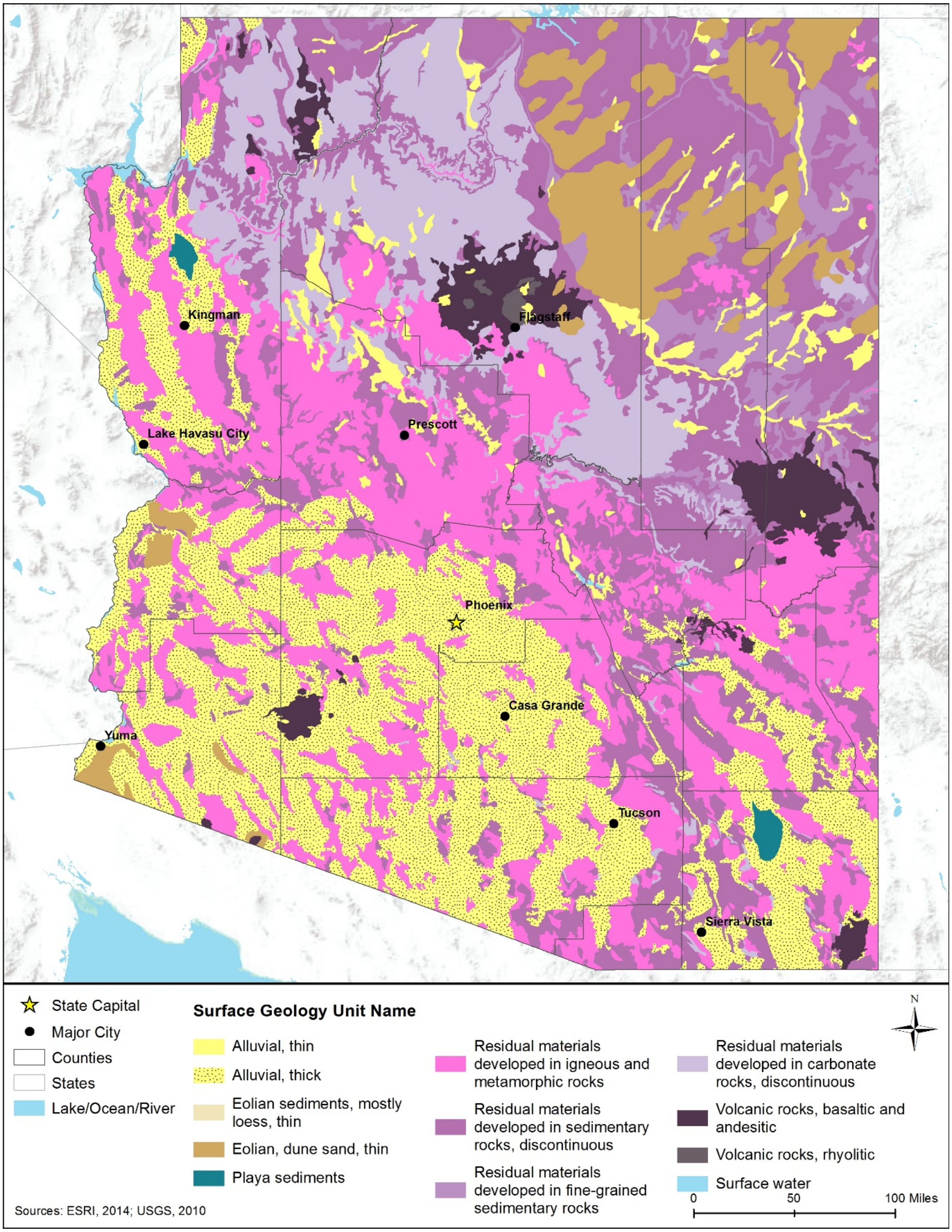


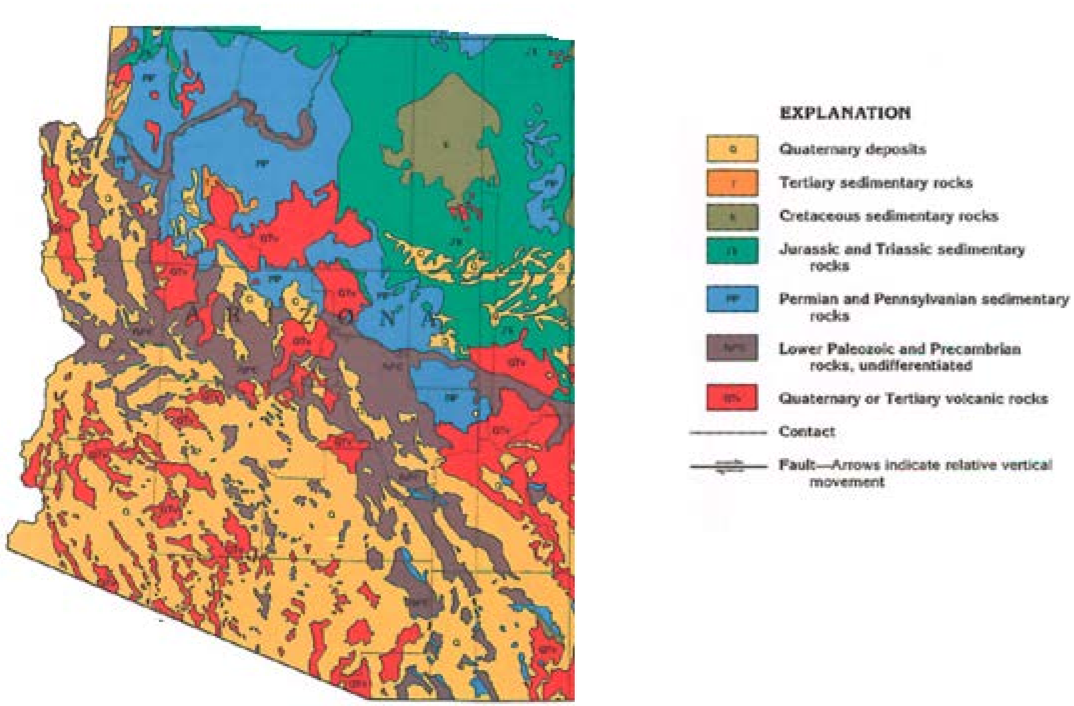
Figure 3.1.3-2: Generalized Surface Geology for Arizona

3.1.3.5. Bedrock Geology

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015a) reveals important information about a region's surface and subsurface characteristics (i.e., 3-dimensional geometry), including dip (slope of the formation),[35] rock composition, and regional tectonism. These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (New Hampshire Department of Environmental Services, 2014).

The majority of the Basin and Range Province in southwestern Arizona is underlain by Quaternary (2.6 MYA to present) surface deposits that include “coarse, poorly sorted alluvial fan and terrace deposits on middle and upper piedmonts and along large drainages; sand, silt and clay on alluvial plains and playas;[36] and wind-blown sand deposits” (USGS, 2016a). The Colorado Plateaus Province in northeastern Arizona is underlain primarily by sedimentary layers that date from the Pennsylvanian (318 to 299 MYA), Permian (299 to 251 MYA) Periods, Triassic (251 to 200 MYA), and Jurassic (200 to 146 MYA) Periods (University of California Museum of Paleontology, 2011). Sedimentary rock layers within northeastern Arizona's Colorado Plateaus Province were uplifted several times over the last 70 MYA, and “approximately 5 [MYA] the entire Rocky Mountains and Colorado Plateau were uplifted 4,000 to 6,000 feet… Present day streams established their courses at this time and because they were lifted high above base level (sea level) they began to rigorously downcut. Deep entrenchment of streams and differential erosion of the plateau began at this time” (Foos, 1999). Within the Grand Canyon, sedimentary rock units dating from between 550 and 250 MYA are exposed in the canyon's walls (NPS, 2015a). Figure 3.1.3-3 displays the general bedrock geology for Arizona.

[35] 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).
[36] Playa: “Shallow, short-lived lakes that form where water drains into basins with no outlet to the sea and quickly evaporates. Playas are common features in arid (desert) regions and are among the flattest landforms in the world.” (USGS, 2015e)



Source: (USGS, 1995a)

Figure 3.1.3-3: Generalized Bedrock Geology for Arizona

3.1.3.6. Paleontological Resources

Most of Arizona was covered by warm, shallow seas during the late Precambrian (4,600 to 542 MYA), with evidence of stromatolite fossils found in limestones from this time period (Paleontology Portal, 2015a) (University of California Museum of Paleontology, 2011). By the Cambrian Period (542 to 488 MYA), central and eastern Arizona were above sea level, while shallow seas covered northern and southern Arizona. The marine environment yielded invertebrate fossils, including brachiopods[37] and trilobites,[38] from limestones, sandstones, and siltstones (Paleontology Portal, 2015b) (University of California Museum of Paleontology, 2011). Shallow seas remained in parts of Arizona through the Devonian Period (416 to 359 MYA), although a few terrestrial environments developed. Arizona's Devonian fossils include

Arizona State Fossil
Petrified Wood

Source: (Arizona Secretary of State, 2015)

[37] 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)
[38] 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)

terrestrial plants, brachiopods, corals, bryozoans,[39] gastropods,[40] and armored fish. Arizona was mostly above sea level during the Permian Period (299 to 251 MYA), though marine fossils have been found from ammonoids, bivalves,[41] natuiloids, and other invertebrates (Paleontology Portal, 2015c) (University of California Museum of Paleontology, 2011). During the Triassic Period (251 to 200 MYA), Arizona was covered by lowlands. These lowlands provided habitat for large reptiles and early dinosaurs, of which tracks and bones have been found. Petrified wood remains from giant conifers are found in northern Arizona, particularly in Petrified Forest National Park (Paleontology Portal, 2015d) (University of California Museum of Paleontology, 2011). By the Cenozoic Era (66 MYA to present), many terrestrial environments existed in the state, including deserts, rivers, lakes, and grasslands. These environments provided habitat for camels, three-toed horses, giant tortoises, and mastodons (Paleontology Portal, 2015e) (University of California Museum of Paleontology, 2011). As presented above, fossils are present throughout the state, with marine and terrestrial fossils present in the Grand Canyon and dinosaur fossils at Petrified Forest Natural Park.

3.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2014, Arizona produced 56 thousand barrels of oil, which is the second lowest amount among oil-producing states (EIA, 2014a). In January 2016, Arizona produced 1,000 barrels of crude oil, ranking 30th nationwide in total production and ahead of only Virginia among oil producing states (EIA, 2015j).

In 2014, Arizona produced 106 million cubic feet of natural gas from five natural gas producing wells (EIA, 2014a).

Minerals

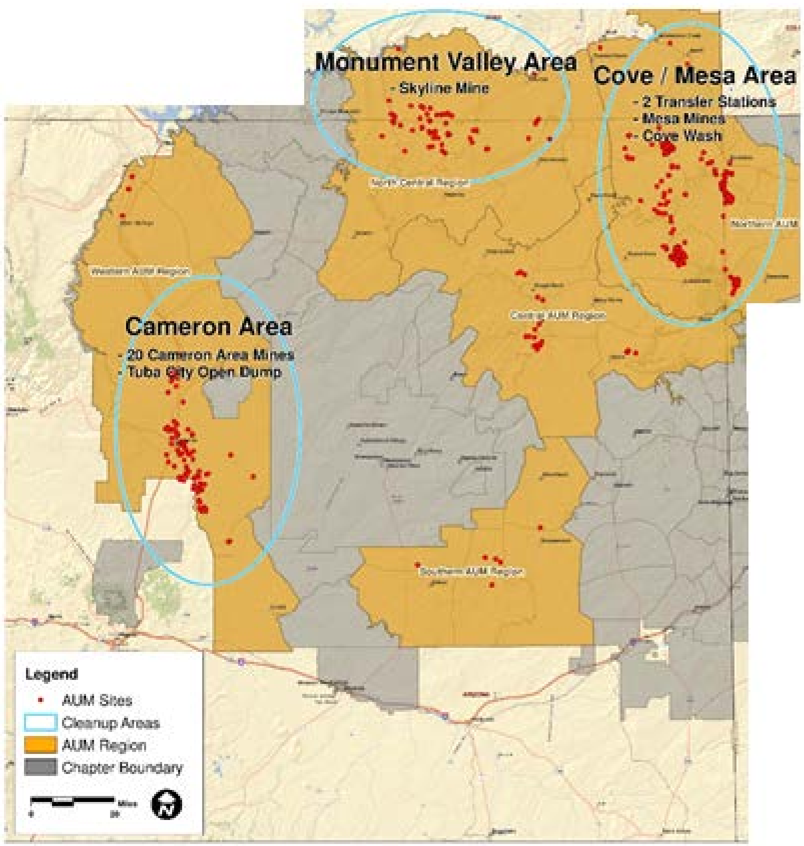
As of 2015, Arizona's total nonfuel mineral production was valued at $6.8B, which ranked second nationwide (in terms of dollar value). This level of production accounted for nine percent of total production mineral value nationwide. As of 2015, Arizona's leading nonfuel minerals were copper, molybdenum concentrates, construction sand and gravel, crushed stone, and Portland cement (USGS, 2016c). Arizona has ranked first nationwide in copper production from 1910 to 2011, and also in 2011 led the country in gemstone production. Other minerals produced in the state are bentonite, crushed stone, common clays and shale, gold, gypsum, magnesium compounds, mica, perlite, pumice, rhenium, vermiculite, zeolites, calcium carbonate, dimension stone,[42] industrial sand, lime, salt, and volcanic cinder (USGS, 2015b).

[39] Bryozoan: "Common name for any member of the phylum Bryozoa. Bryozoans are invertebrate aquatic organisms most commonly found in large colonies." (Smithsonian Institution, 2016)
[40] 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)
[41] Bivalve: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing." (Smithsonian Institution, 2016)
[42] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape." (USGS, 2016b)

Arizona is also producer of commercial coal, and has one operating coalmine and two known coalfields. The Black Mesa coalfield is in northeast Arizona, while the Pinedale coalfield is in south central Arizona (EIA, 2015b). Kayenta is the only active coalmine in Arizona and is located on the Navajo and Hopi reservations. In 2013, Arizona produced 7,603 thousand short tons on coal, which ranked 16th nationwide for total coal production. This production value accounted for 0.8 percent of the nation's total coal production (EIA, 2014a).

Arizona is one of a few states known to possess extensive uranium deposits (EIA, 2014b). In northwestern Arizona, uranium is found within breccia[43] pipes, which can reach 300 to 500 feet in diameter (USGS, 2011a). As of 2010, there were nine underground mines with breccia-pipe uranium production, eight of which are near Kanab Creek north of the Grand Canyon (AZGS, 2011a). The Monument Valley district, Cameron area, Lukachukai Mountains, and Carrizo Mountain district in northeastern Arizona all contain uranium deposits as well (AZGS, 2013) (AZGS, 2015a) (Chenowith, 1985) (AZGS, 2011b).

Figure 3.1.3-4 displays abandoned uranium mine (AUM) sites throughout northeast Arizona.



Source: (USEPA, 2016a)

Figure 3.1.3-4: Abandoned Uranium Mine Sites in Northeast Arizona

[43] Breccia: "Rock made up of angular fragments of other rocks held together by mineral cement or a fine-grained matrix." (USGS, 2015e)

3.1.3.8. Geologic Hazards

The three major geologic hazards of concern in Arizona are earthquakes, landslides, and subsidence. The subsections below summarize current geologic hazards in Arizona.

Earthquakes

Areas of greatest seismicity in Arizona are concentrated in the northwestern and southwestern portions of the state. Between 1973 and March 2012, there were five earthquakes of a magnitude 4.5 (on the Richter scale[44]) or greater in Arizona (USGS, 2014c). Earthquakes are the result of large masses of rock moving against each other along fractures called faults. Earthquakes occur when landmasses on opposite sides of a fault suddenly slip past each other; the grinding motion of each landmass sends out shock waves. The vibrations travel through the Earth and, if they are strong enough, they can damage manmade structures on the surface. Earthquakes can produce secondary flooding impacts resulting from dam failure (USGS, 2012a).

The shaking due to earthquakes can be significant many miles from its point of origin depending on the type of earthquake and the type of rock and soils beneath a given location. Crustal earthquakes, the most common, typically occur at depths of 6 to 12 miles; these earthquakes typically do not reach magnitudes higher than 6.0 on the Richter scale. Subductio5n 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” (Oregon Department of Geology 2015). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (Oregon Department of Geology, 2015). “Although southeastern Arizona is several hundred miles from the San Andreas Fault system, it is not immune to earthquakes. By the time the surface waves of these large events reach southeastern Arizona, the energy has dissipated so that little or no motion is felt except by sensitive recording devices.” (AZGS, 1987) However, according to the Arizona Geological Survey, “Although seismic hazard is fairly low in much of Arizona, it is relatively high in the Yuma area. Yuma is close to active faults in the Imperial Valley in southern California and northern Mexico that have generated numerous magnitude 6.5 to 7.0 earthquakes during the last 150 years.” (AZGS, 2015b)

Figure 3.1.3-5 depicts the seismic risk throughout Arizona; the box surrounding the range of colors shows the seismic hazards in the state. The map indicates levels of horizontal shaking (measured in Peak Ground Acceleration) that have a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 % g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 % g. (USGS, 2010)

The most damaging earthquake recorded in Arizona occurred in Sonora (Mexico) in 1887, resulting in significant damage in southeastern Arizona. “The Yuma area experienced strong

[44] 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, 2014g).

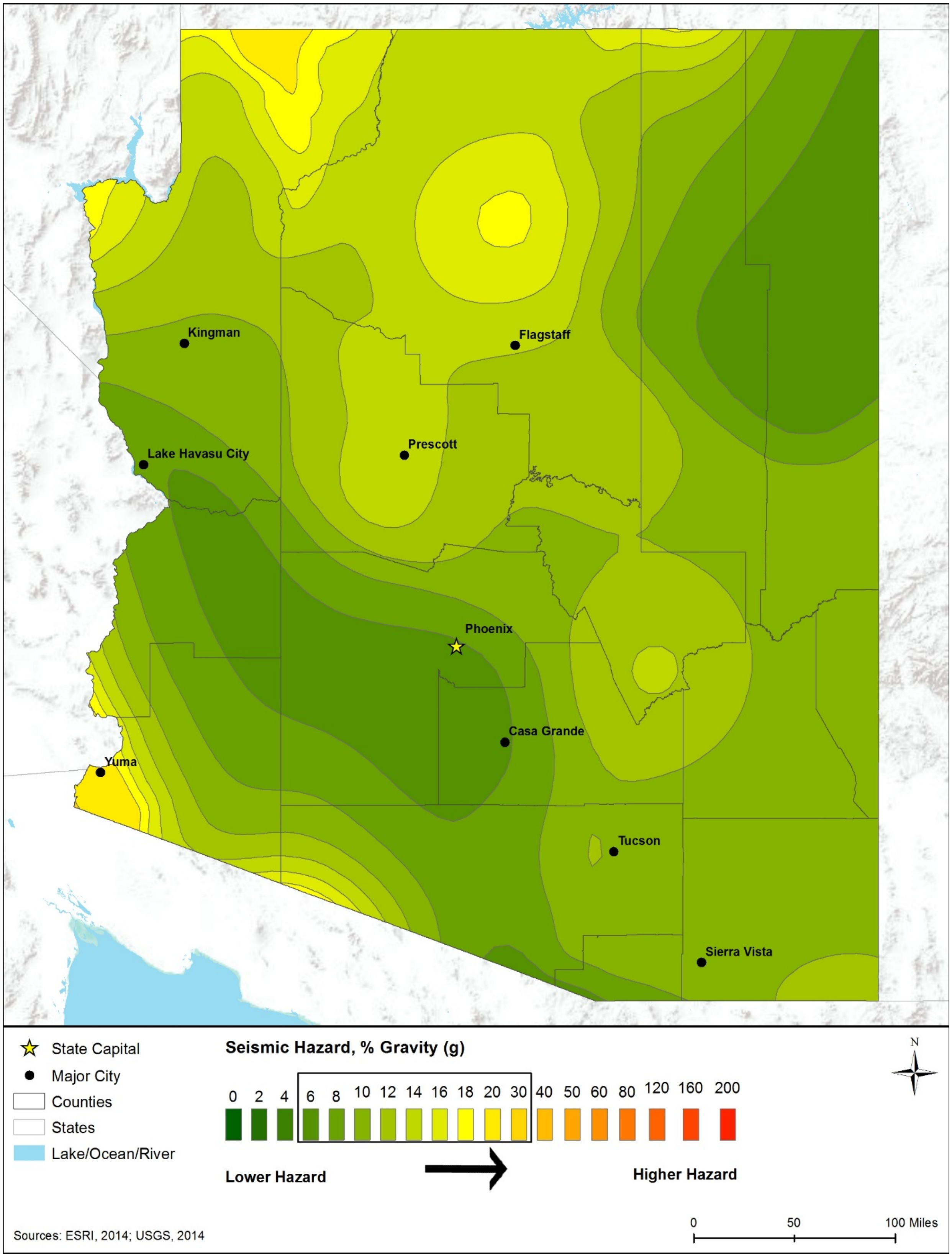


Figure 3.1.3-5: Arizona 2014 Seismic Hazard Map

shaking and significant damage because of the 1940 Imperial Valley earthquake in southern California. Three magnitude 6 earthquakes in the early 1900's caused some damage in the Flagstaff-Grand Canyon region." (AZGS, 1987) (Northern Arizona University, 2010)

Landslides

Landslides frequently occur in parts of Arizona, particularly in mountainous areas (AZGS, 2015c). "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, 2003). 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, 2003).

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, 2003)

Photo of Collapsed Section of U.S. Route 89

Source: (Conway, 2014)

Landslides have been documented in every county throughout Arizona, including in close proximity to major cities such as Phoenix, Tucson, and Flagstaff. These landslide events have "have caused tens of millions of dollars of damage to infrastructure and property" (AZGS, 2015c). Five significant landslide events occurred in Arizona between 2006 and 2013 (AZGS, 2015c). In July 2006, a series of more than 400 debris flow[45] landslides was documented near Tucson following five days of torrential downpours in the southeastern part of the state. The landslides were confined to mountain ravines so they did not cause any injuries or fatalities. In February 2013, a landslide near the city of Page forced the closure of 23 miles along U.S. Route 89 at a cost of more than $25M. "The slidemass at U.S. Route 89 is part of a larger ancient landslide block adjacent to the Echo Cliffs. This larger landslide is referred to as a Toreva block slide, characterized by competent rock resting on less competent material that fails, slides downslope and rotates such that the strata dips back into the hillslope" (Conway, 2014). Figure 3.1.3-6 displays landslide incidence and susceptibility throughout Arizona.

[45] Debris Flow: "A type of landslide made up of a mixture of water-saturated rock debris and soil with a consistency similar to wet cement. Debris flows move rapidly downslope under the influence of gravity." (USGS, 2015e)

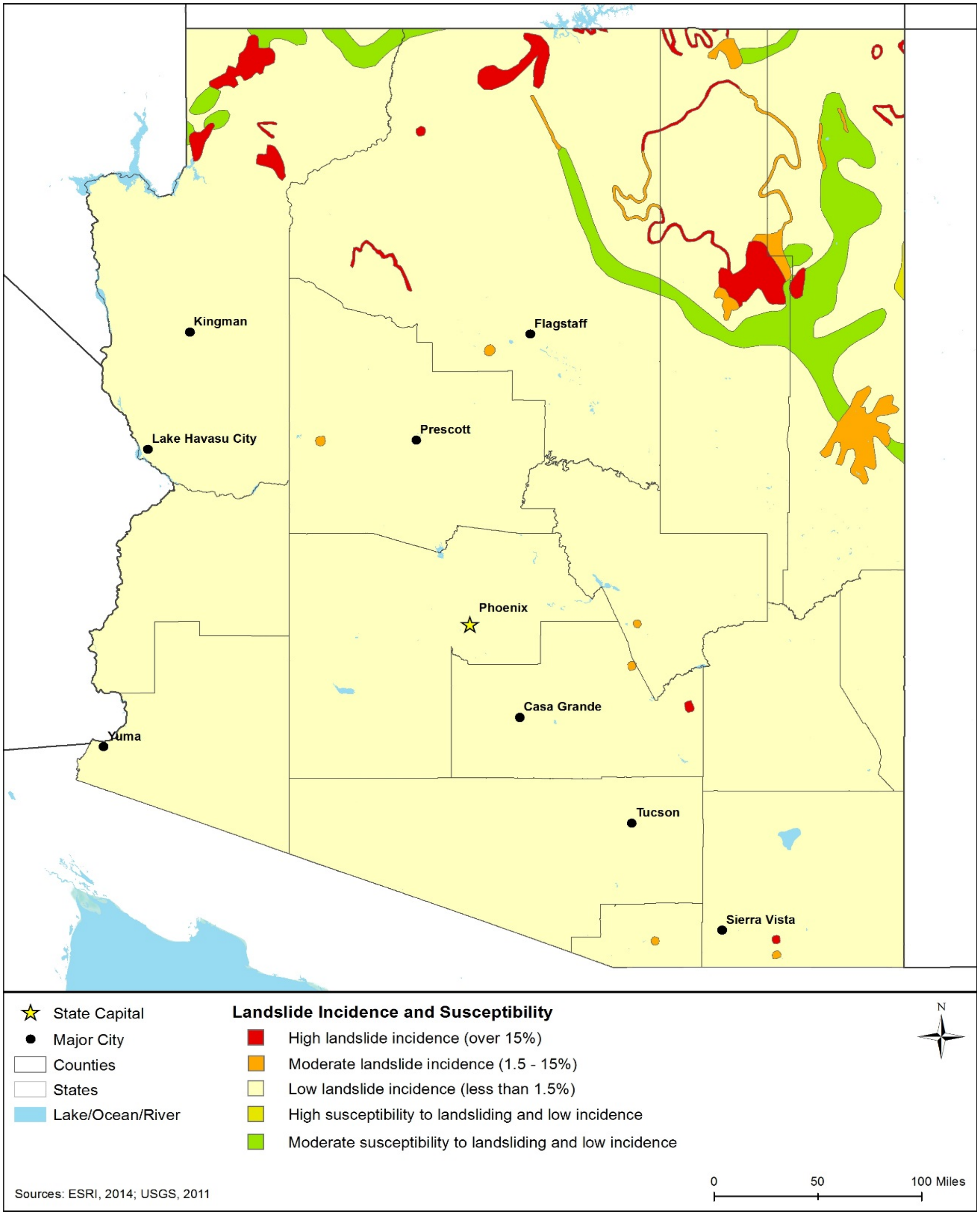


Figure 3.1.3-6: Arizona Landslide Incidence and Susceptibility Hazard Map[46]

[46] Susceptibility hazards not indicated in Figure 3.1.3-6 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying the incidence of landslides. Some generalization was necessary at this scale, and several small areas of high incidence and susceptibility were slightly exaggerated. (USGS, 2014h)

Land Subsidence

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." Land subsidence has been documented in parts of Arizona for nearly a century (ADWR, 2015a). Nationwide, the primary causes of land subsidence are attributed to aquifer system compaction, drainage of organic soils, underground mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the United States is a consequence of over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

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

In Arizona, a significant cause of land subsidence is the aquifer compaction caused by lowering of the water table. Parts of Maricopa and Pinal Counties have dropped more than 18 feet over the last 100 years (ADWR, 2015a). Land subsidence has occurred in the Tucson area due to compaction of silt and clay aquifer units in the Fort Lowell and Tinaja formations. These upper stratigraphic units date to the Pleistocene (2.6 MYA to 11,700 years ago) and Holocene (11,700 years ago to present) Epochs. "The upper Tinaja beds are gravel to clayey silt and are hundreds to thousands of feet thick. The Fort Lowell Formation consists of gravel to clayey silt and includes thin surficial alluvial deposits of late Pleistocene and Holocene age." Between 1987 and 1998, some portions of the Tucson Basin experienced three to four inches of land subsidence due to aquifer compaction (Carruth, Pool, & Anderson, 2007). Subsidence rates in the Tucson area during the mid to late 1900's were roughly 0.6 to 0.8 inch per year (AZGS, 2015d).

Arizona also has experienced land subsidence due to earth fissures.[47] "Earth fissures are cracks at or near the earth's surface that are the result of differential subsidence." Earth fissures are particularly common in southern Arizona in areas that have experienced aquifer compaction. (ADWR, 2015a) A seven-mile long fissure system has developed near the town of Eloy (about 60 miles northwest of Tucson), with the largest fissure being 30 feet wide and 50 feet deep (AZGS, 2015d). Fissures can cause extensive damage to overlying infrastructure and buildings (ADWR, 2015a).

[47] Fissure: "Elongate, narrow fractures." (USGS, 2015e)

3.1.4. Water Resources

3.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 3.1.5). 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, 2014d)

3.1.4.2. 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 3.1.4-1 summarizes the major Arizona laws and permitting requirements relevant to the state's water resources.

Table 3.1.4-1: Major Relevant Arizona Water Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
Public Water Code	AZ Department of Water Resources	Water rights permits for actions including appropriating public water, reservoir construction, and claiming rights to a stockpond (ADWR, 2016).
AZPDES Program	ADEQ	Construction sites that disturb one or more acre of surface soil (ADEQ, 2013b).
Clean Water Act (CWA) Section 404 permit, Nationwide Permit (NWP) Wyoming regional conditions	U.S. Army Corps of Engineers (USACE), Omaha District	USACE must be notified prior to dredge and fill activities authorized under NWPs in wetlands adjacent to the following waterbodies: parts on the Snake, Green, Wind, North Platte, Middle Fork, Powder, Tongue, Sweetwater, Encampment, and Clarks Fork Rivers; Sand, Fish, and Granite Creeks; and Fremont Lake (USACE, 2012).
CWA Section 401 permit	ADEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from ADEQ indicating that the proposed activity will not violate water quality standards (ADEQ, 2015k).

3.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams. Arizona has 127,505 miles of streams and rivers (USEPA, 2000). Surface water supply can vary dramatically in Arizona's desert environment, and therefore, reservoirs have been constructed along major rivers such as the Agua Fria, Gila, Salt, and Verde Rivers, for storage and delivery of water. The Colorado River is also a major supplier of water to the state, with Arizona using 2.77 million acre-feet of water in 2014(Arizona Water Banking Authority, 2016).

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). Arizona's waters (lakes, rivers, and streams) are divided into 10 major watersheds or drainage basins (Figure 3.1.4-1). Visit https://www.azdeq.gov/environ/water/watershed/index.html for information and additional maps about each ADEQ watershed's location, size, and water quality (ADEQ, 2015l).

The Middle Gila Watershed covers just over 12,000 square miles, and includes the Phoenix metropolitan area and the Phoenix Active Management Area (AMA) (ADEQ, 2008). The Phoenix AMA is one of five AMAs designated under the 1980 Groundwater Code under the Arizona Department of Water Resources. By statute, the Phoenix AMA is required "to achieve safe-yield by the year 2025 through the increased use of renewable water supplies and decreased groundwater withdrawals in conjunction with efficient water use" (ADWR, 2015b). In northeastern Arizona, the Little Colorado Watershed covers over 27,000 square miles, or nearly 20 percent of the state. It extends from the mountains in the Apache National Forest to the confluence of the Colorado River in the Grand Canyon (ADEQ, 2006). The Colorado-Lower Gila Watershed is in far southwestern Arizona, and covers approximately 14,000 square miles, including the Colorado River below the Hoover Dam south to the United States border with Mexico (ADEQ, 2010a).

Freshwater

As shown in Figure 3.1.4-1, major rivers in Arizona include the Colorado, Little Colorado, Gila, Verde, and Salt. The Colorado River, the seventh longest river in the United States, forms the border between Arizona and California, as well as a portion of the border between Arizona and Nevada (ADEQ, 2010b). The Little Colorado River flows almost entirely in Arizona, for over 300 miles, until its confluence with the Colorado River. The Salt River also flows for 200 miles through central Arizona, and provides irrigation water to the Phoenix area. The Verde River, also in central Arizona, flows for nearly 200 miles until its confluence with the Salt River. Major lakes and reservoirs in Arizona include Lake Powell, Lake Mead, Lake Havasu, and Roosevelt Lake (NRCS, 2015b).

Lake Powell, north of Page, AZ, was created by the construction of Glen Canyon Dam along the Colorado River (BOR, 2008). The lake stretches north into Utah, for a total of just under 200 miles. Lake Powell is the second largest manmade reservoir in the country, with over 2,000 miles of shoreline. Lakes Mead and Havasu are also located along the Colorado River (see Figure 3.1.4-1). Lake Havasu is one of the most popular lakes for recreation in the state. It was created by the construction of the Parker Dam, and is approximately 45 miles long. Roosevelt Lake, at the confluence of the Salt River and Tonto Creek, covers an area more than 17,000 acres. (NRCS, 2015b)

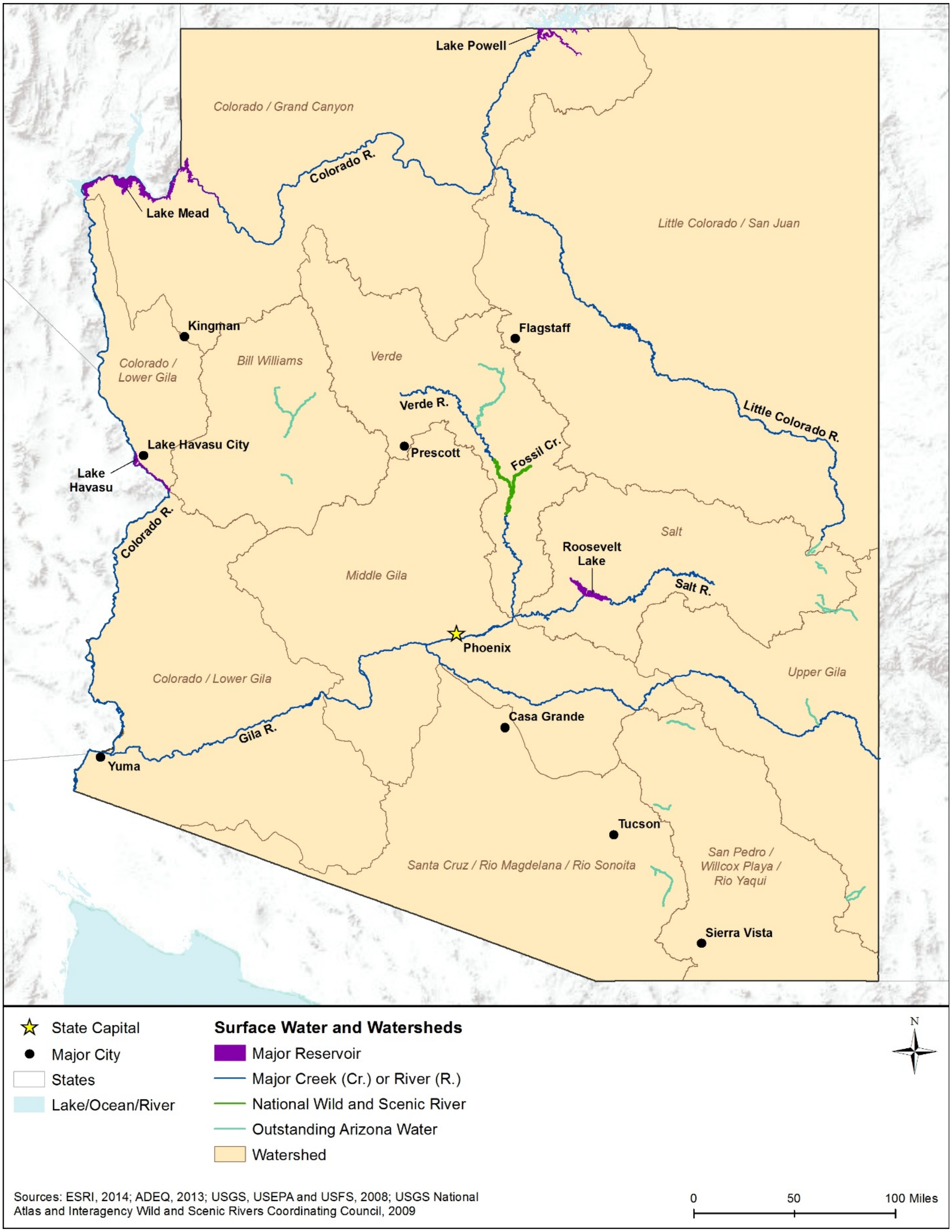


Figure 3.1.4-1: Major Arizona Watersheds and Surface Waterbodies

3.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Fossil Creek, between its confluence with the Verde River and the Sand Creek and Calf Pen Canyons (Figure 3.1.4-1) is a federally designated National Wild and Scenic River in Arizona (National Wild and Scenic Rivers System, 2015a). At nearly 17 miles, Fossil Creek contains some of the most diverse riparian habitat in the state. Nine miles are classified as wild and almost eight miles are classified as recreational (NPS, 2015a). The Verde River, in Central Arizona, is also a federally designated National Wild and Scenic River. Twenty-two miles are classified as wild and 18 are classified as scenic. The Verde River contains outstanding cultural and historical sites, fish and wildlife habitat, and scenic values (NPS, 2015b). See Section 3.1.6 for detailed information on Arizona fisheries resources.

Outstanding Arizona Waters

Outstanding Arizona Waters are surface waters designated by the ADEQ that are either perennial or intermittent, and are in a free-flowing condition. The surface water must also have good water quality that meets or exceeds the applicable surface water quality standards. In addition, the surface water must either be of exceptional recreational or ecological significance, or an endangered or threatened species must be associated with the surface water, and therefore excellent surface water quality is needed to either maintain and propagate, or provide habitat for the species (State of Arizona, 2015). A list of Outstanding Arizona Waters can be found here: http://www.azdeq.gov/environ/water/permits/download/oaw.pdf.

3.1.4.5. 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 (ADEQ, 2015s). Under Section 303(d) of the Clean Water Act, states are required to assess water quality and report a listing of impaired waters,[48] the causes of impairment, and probable sources. Table 3.1.4-2 summarizes the water quality of Arizona's assessed major waterbodies by category, percent impaired, designated use,[49] cause, and probable sources. Figure 3.1.4-2 shows the Section 303(d) waters in Arizona as of 2010.

As shown in Table 3.1.4-2, various sources affect Arizona's waterbodies, causing impairments. Of the 29 percent of lakes, reservoirs, and ponds that have been assessed in Arizona, more than half are impaired. Designated uses include agricultural irrigation, agricultural livestock watering, aquatic and wildlife (warm and cold-water fisheries and effluent dependent water), fish consumption, and full and partial body contact. (USEPA, 2015a)

[48] Impaired waters: Waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters (USEPA, 2015b).
[49] Designated Use: An appropriate intended use by humans and/or aquatic life for a waterbody. Designated uses may include recreation, shellfishing, or drinking water supply (USEPA, 2015b).

Table 3.1.4-2: Section 303(d) Impaired Waters of Arizona, 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	3%	45%	Agricultural irrigation, agricultural livestock watering, aquatic and wildlife	Pathogens,[c] metals such as copper and selenium, and sediment	Natural sources, rangeland grazing, mine tailings, impacts from hydrostructure flow regulation/modification,
Lakes, Reservoirs, and Ponds	29%	75%	Agricultural irrigation, agricultural livestock watering, aquatic and wildlife	Mercury, metals such as selenium, dissolved oxygen, and pH	Impacts from abandoned mine lands, sources outside state jurisdiction or borders, and natural sources

Source: (USEPA, 2015a)

[a] Some waters may be considered for more than one water type.
[b] Arizona has not assessed all waterbodies within the state.
[c] Pathogen: a bacterium, virus, or other microorganism that can cause disease (USEPA, 2015b).

The greatest threats to water quality in Arizona are metals, and pollutants from runoff. Surface water can contain metals through natural processes, such as groundwater recharge, along with runoff from mining activities that expose rock and soil. Sediment runoff from both urban areas and agricultural and grazing practices can carry pollutants such as nitrogen and phosphorus, metals, pesticides, and petroleum products into surface water bodies. Sediments containing mercury have also been an issue in several Arizona lakes, where fish consumption advisories are in place. It is unclear whether these high concentrations are naturally occurring or elevated by human activity. (ADEQ, 2002)

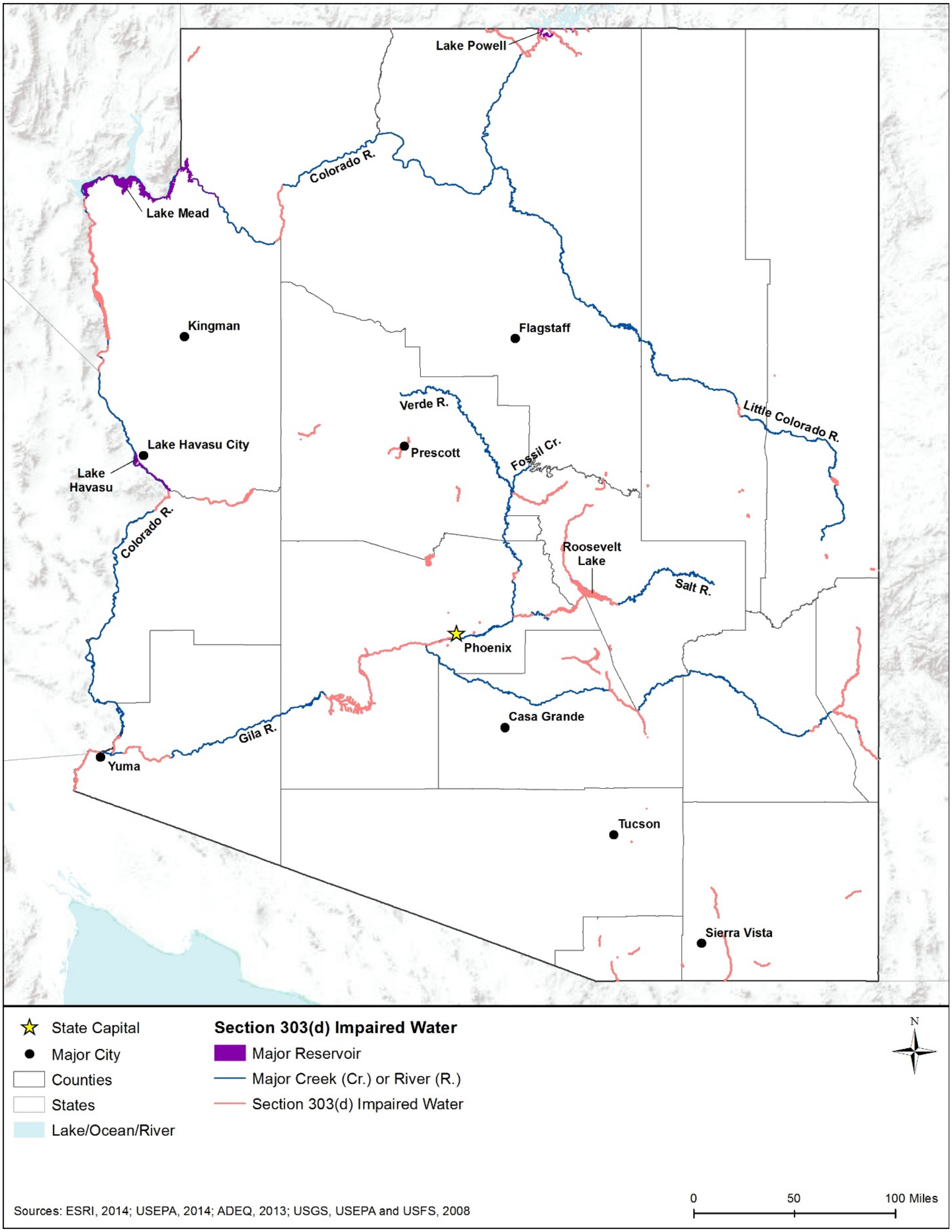


Figure 3.1.4-2: Section 303(d) Impaired Waters of Arizona, 2010

3.1.4.6. Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as "any land area susceptible to being inundated by water from any source" (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000).[50] 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)

Arizona has regional and flash floods (AZGS, 2015e). They occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous areas, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water (FEMA, 2014b).

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015a). There are several causes of flooding in Arizona, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. These include post-fire flooding along with seasonal weather conditions including summer monsoons,[51] winter rains, and remnants of tropical storms that result in flash flood events (AZDEMA, 2013a).

Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is free from flood risk. Approximately four percent of the state's population is located in high flood hazard areas. Greenlee, Santa Cruz, Yavapai, and Pima counties have the highest risk of flooding and flash flooding (AZDEMA, 2013a). Local communities often have floodplain

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

[51] Monsoon: "The North American monsoon (NA monsoon), variously known as the Southwest United States monsoon, the Mexican monsoon, or the Arizona monsoon, is experienced as a pronounced increase in rainfall from an extremely dry June to a rainy July over large areas of the southwestern United States and northwestern Mexico. These summer rains typically last until mid-September when a drier regime is reestablished over the region." (USGS, 2013c)

management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to over 100 communities in Arizona through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, 32 Arizona communities participate in the CRS (FEMA, 2014d).[52]

3.1.4.7. 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 (USGS, 1999). When the water table reaches the ground surface, groundwater will reappear as either streams, surface bodies of water, or wetlands. This exchange between surface water and groundwater is an important feature of the hydrologic (water) cycle.

Arizona's principal aquifers consist of basin-fill and carbonate-rock,[53] alluvial aquifers, along with sandstone aquifers[54] (Moody, Carr, Chase, & Paulson, 1986). Groundwater is the primary source of water in the state, supplying approximately 43 percent of the population with drinking water (AZDWR, 2016).

"Arizona has a varied groundwater quality mainly due to its mineral-rich and complex geology. Most of the groundwater resources are located in the basin and range aquifers filled with sediments thousands to millions years old [and] the water quality varies from basin to basin, and within each basin, due to a unique combination of factors such as aquifer sediment composition, basin origins, and its present hydrology." Generally, about one-third of the groundwater samples in Arizona have been found to exceed one or more Maximum Contaminant Level (MCL).[55] More than "97% of these exceedances were due at least to one of these four constituents:

[52] A list of the 32 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).

[53] 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).

[54] 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).

[55] Current MCLs are USEPA National Primary and Secondary Drinking Water Standards (ADEQ, 2016c).

arsenic, fluoride, nitrate, and gross alpha radiation." Some Arizona aquifers are also impaired by high salt concentrations, "due to natural local geologic conditions, [generally in] the Phoenix basin along the Salt River, the Gila River into the Yuma valley, and on the Holbrook basin located on the Colorado plateau." Shallow aquifers, including those used by private wells, are potentially impacted by anthropogenic[56] activities and contaminated by "site-specific conditions such as septic systems and nearby activities like agriculture or mining." (Artiola, Hix, Gerba, & Riley, 2014)

Table 3.1.4-3 provides details on aquifer characteristics in the state. Figure 3.1.4-3 shows Arizona's principal and sole source aquifers.

Table 3.1.4-3: Description of Arizona's Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Basin and Range basin-fill aquifers Alluvial aquifers, with localized areas of volcanic rock and evaporate deposits. Consist primarily of moderately consolidated to unconsolidated beds of clay, sand, silt, and gravel	Found in the southern half and western portion of Arizona.	Generally acceptable for most uses, although some areas of dissolved fluoride concentrations above maximum contaminant levels.
Basin and Range carbonate-rock aquifers Alluvial aquifers, with localized areas of volcanic rock and evaporate deposits and carbonate bedrock	Found in small areas in central and southeastern Arizona.	Generally acceptable for most uses, although some areas of dissolved fluoride concentrations above maximum contaminant levels.
Colorado Plateaus aquifers Primarily sandstone and limestone	Found in the northeastern portion of Arizona.	Water quality is generally acceptable for most uses.

Sources: (Moody, Carr, Chase, & Paulson, 1986), (USGS, 1995b)

Sole Source Aquifers

The 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, 2015c). Arizona has two designated SSAs within the state, the Upper Santa Cruz and Avra Basin Aquifer and the Bisbee-Naco Aquifer (USEPA, 2015d) (Figure 3.1.4-3). 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, 2015c).

[56] 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, 2016f)

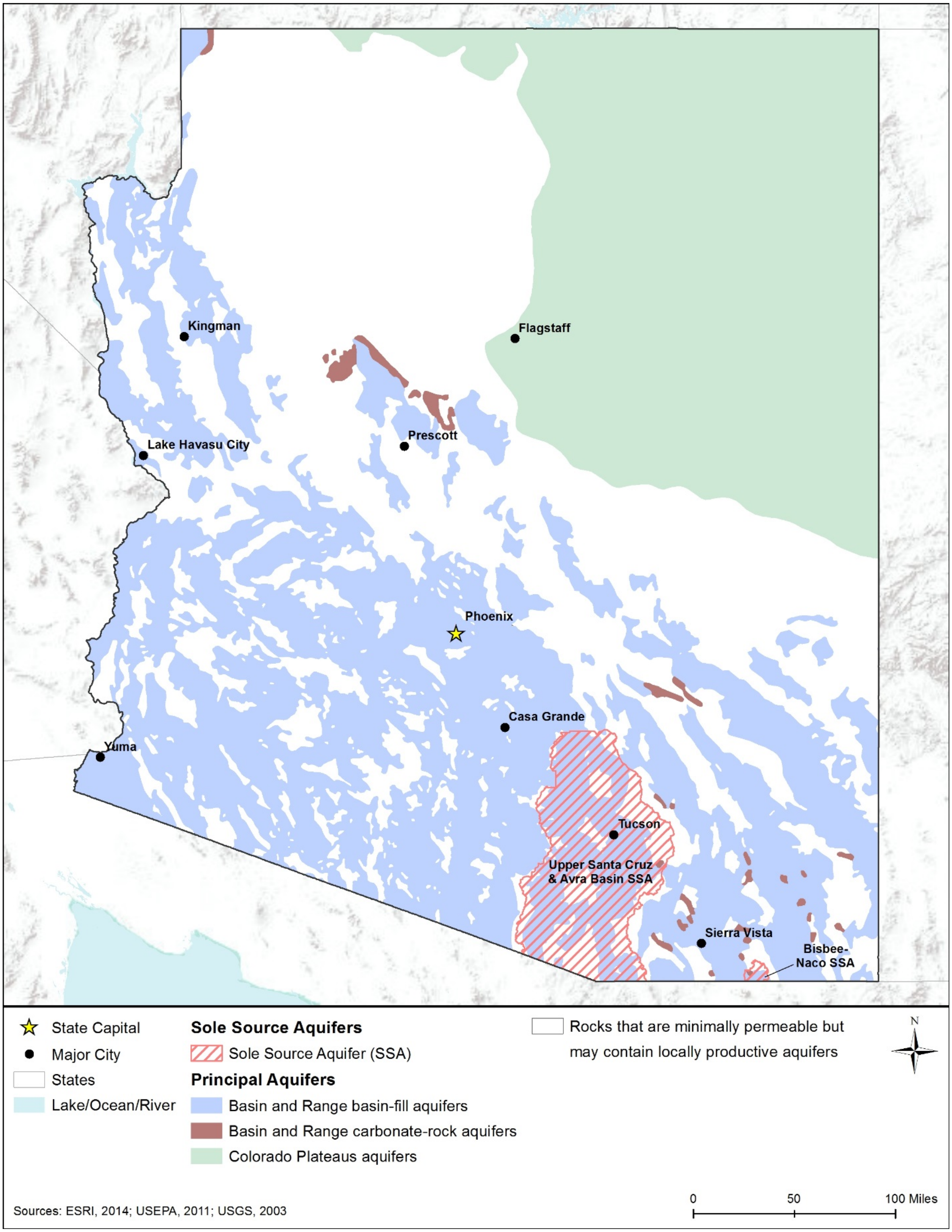


Figure 3.1.4-3: Principal and Sole Source Aquifers of Arizona Wetlands

3.1.5. Wetlands

3.1.5.1. Definition of the Resource

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

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

3.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 3.1.5-1 summarizes the major Arizona state laws and permitting requirements relevant to the state's wetlands.

Table 3.1.5-1: Relevant Arizona Wetlands Laws and Regulations

State Law/ Regulation	Regulatory Authority	Applicability
CWA Section 404 permit, NWP Arizona regional conditions	USACE, Los Angeles District	NWPs 12 (Utility Line Activities) and 39 (Commercial and Institutional Development) cannot be used for any activities (such as construction of structures, or the discharge of dredged or fill material) resulting in the loss of wetlands.
AZPDES Program	ADEQ	Construction sites that disturb one or more acre of surface soil.
CWA Section 401 permit	ADEQ	In accordance with Section 401 of the CWA, activities that may result in a discharge to waters of the U.S. require a Water Quality Certification from ADEQ indicating that the proposed activity will not violate water quality standards.

3.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as detailed in Table 3.1.5-2. The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 3.1.3-5). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats. (USFWS, 2015a)

- "The Marine System consists of the open ocean overlying the continental shelf and its associated high-energy coastline. Marine habitats are exposed to the waves and currents of the open ocean and the Water Regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 30 parts per thousand (ppt), with little or no dilution except outside the mouths of estuaries." Where wave energy is low, mangroves or mudflats may be present.
- "The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and the ocean water is at least occasionally diluted by freshwater runoff from the land."
- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt."
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The System is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types). (Cowardin, Carter, Golet, & LaRoe, Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31, 1979)

In Arizona, the main type of wetland is the palustrine (freshwater) wetland. These wetlands are found on river and lake floodplains across the state. Riverine and lacustrine wetlands and the second most comment wetlands in Arizona. They are also found primarily along rivers, lakes, and reservoirs throughout the state.

Table 3.1.5-2 uses 2014 NWI data to characterize and map Arizona wetlands on a broad-scale.[57] 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 conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure 3.1.5-1, palustrine, riverine, and lacustrine wetlands are found throughout the state. The map codes and colorings in Table 3.1.5-2 correspond to the wetland types in the figures.

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

Table 3.1.5-2: Arizona 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.	Across the state, primarily along streams and rivers	188,620
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens, prairie potholes, and sloughs.	Across the state, primarily along streams and rivers	27,124
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%.	Across the state, primarily along streams and rivers	22,954
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep[58], and other miscellaneous wetlands are included in this group.	Throughout the state	14,210
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, along rivers	49,055
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 generally less than 8.2 feet deep.	Throughout the state, around lakes and reservoirs	77,775
			TOTAL	**379,738**

Sources: (Cowardin, Carter, Golet, & LaRoe, Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31, 1979) (USFWS, 2015c) (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).

[58] 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).

Wetlands

The majority of freshwater wetlands in Arizona are found in riparian areas, and include marshes, bosques,[59] cienegas,[60] and oxbow lakes.[61] Non-riparian wetlands include playas,[62] caldera lakes,[63] and tinajas.[64] These wetlands comprise less than one percent of Arizona, and it is estimated more than one-third of wetlands in the state have been lost since the late 1800's, due to stream modification and draining. The extremely arid climate, along with seasonal precipitation that varies from year to year, heavily influence the amount and distribution of wetlands in the state. There are no specific water quality regulations for wetlands in Arizona, and wetlands in the state have not been extensively studied. (ADEQ, 2011) (Yuhas, 1996)

Based on the USFWS NWI 2014 analysis, PFO/PSS is the dominant wetland type (50 percent), followed by Lacustrine (20 percent), riverine (13 percent), PEM (7 percent), PUB/PAB (ponds) (6 percent), and other palustrine wetlands (4 percent). There are currently about 380,000 acres of wetlands in the state. (USFWS, 2014a)

There are no high quality wetlands of special value in Arizona.

Important Wetland Sites in Arizona

Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including NRCS, U.S. Fish and Wildlife Service, Arizona State Parks, and easements managed by natural resource conservation groups such as Malpai Borderlands Group and state land trusts. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds more than 4,400 acres in conservation easements in Arizona (NCED, 2015).

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[59] Bosque: "Mesquite bosques, or woodlands, are potentially important and diverse habitats that occur in the Sonoran Desert and other parts of the arid Southwest. These bosques consist of primarily mesquite trees and a diverse understory of vegetation that may provide habitat for a wide-variety of species." (AZGFD, 2013e)

[60] Cienegas are wetlands associated with headwater streams and perennial streams. The water source barely fluctuates, and the soils are permanently saturated (BLM, 1987).

[61] Oxbow Lake: "Small, U-shaped lakes formed when a meander bend is cut off from the main stream channel of a river or stream" (USDA, 2016c).

[62] Playa Lake: "Round hollows in the ground in the Southern High Plains of the United States. They are ephemeral, meaning that they are only present at certain times of the year" (USEPA, 2015e).

[63] Caldera: "Broad volcanic depressions created as the ground surface collapses as a result of withdrawal of partially molten rock (magma) below" (USGS, 2015g).

[64] Tinajas are depressions formed in bedrock. Sometimes referred to as potholes or weathering pits, they range in depth from less than one meter to over two meters, and are characterized by species such as cottonwood, willow, Baltic rush, common reed, and evening primrose. (McKinstry, Hubert, & Anderson, 2004)

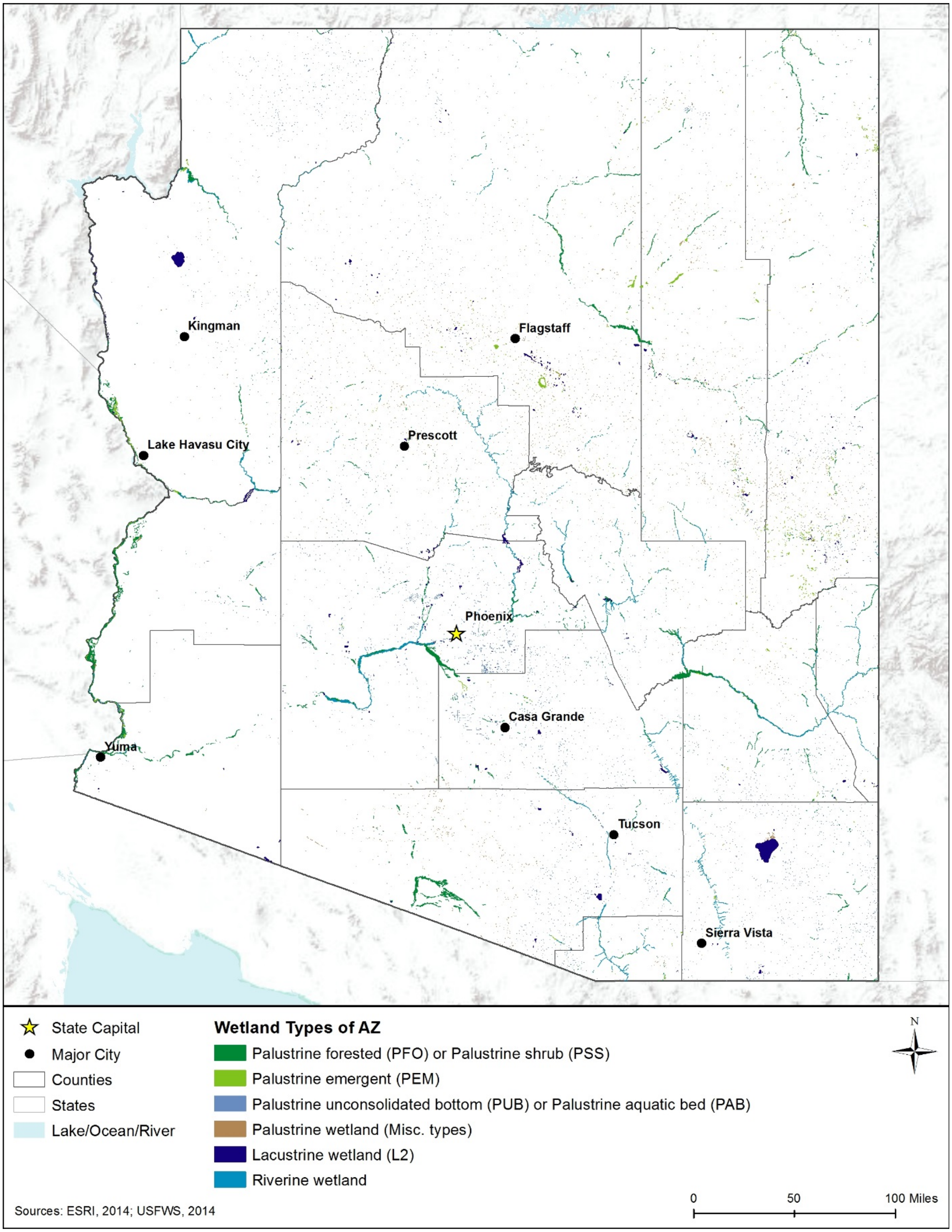

Figure 3.1.5-1: Wetlands by Type, Arizona, 2014

3.1.6. Biological Resources

3.1.6.1. Definition of the Resource

This Chapter describes the biological resources of Arizona. Biological resources include terrestrial[65] vegetation, wildlife, fisheries and aquatic[66] habitats, and threatened[67] and endangered[68] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Because of the significant topographic, geologic, and climatic variation within the state, Arizona supports a wide diversity[69] of biological resources. Within Arizona, all four North American deserts occur, as well as grasslands, woodlands, montane and alpine forests, and alpine tundra (Landau, F., 2016). Each of these topics is discussed in more detail below.

3.1.6.2. Specific Regulatory Considerations

Federal laws relevant to the protection and management of biological resources in Arizona are summarized in detail in Appendix C, Environmental Laws and Regulations and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 3.1.6-1 summarizes major state laws relevant to Arizona's biological resources.

Table 3.1.6-1: Relevant Arizona Biological Resources Laws and Regulations

Law/Regulation	Regulatory Agency	Applicability
Aquatic Invasive Species Interdiction Act (Arizona Revised Statutes [ARS] §17-255 et seq.)	Arizona Game and Fish Department (AZGFD)	This law was passed in 2009 and created a program for addressing aquatic invasive species and establishes prohibitions, penalties, protocols to manage aquatic species with the potential to cause economic or environmental harm.
Arizona Noxious Weed Law §3-201 et seq. ARS and Arizona Noxious Seed Law §3-231 et seq. ARS	Arizona Department of Agriculture (ADA)	As set forth under the provisions of this act, the Arizona Department of Agriculture (ADA) is responsible for managing the control, treatment, and transport of noxious weed species, and establishing and updating the list of prohibited and regulated noxious weeds.
Taking and Handling of Wildlife (ARS §17-268, §17-296, §17-314)	AZGFD	ARS §17-268 and ARS §17-314 establish monetary civil penalty for the possession or taking of listed species of wildlife and endangered/nongame wildlife. This fine goes to the state wildlife theft prevention fund. ARS §17-296 establishes a game, non-game, fish and endangered species fund to be used for the protection and management of sensitive habitat.

[65] Terrestrial: "Pertaining to land" (USEPA, 2015t).
[66] Aquatic: "Pertaining to water" (USEPA, 2015t).
[67] 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)).
[68] 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)).
[69] Diversity: "An ecological measure of the variety of organisms present in a habitat" (USEPA, 2015t).

3.1.6.3. Terrestrial Vegetation

The distribution of flora within the state is a function of the characteristic geology,[70] soils, climate,[71] and water of a given geographic area and correlates with distinct areas identified as ecoregions.[72] Ecoregions are broadly defined areas that share similar characteristics, such as climate,[73] geology, soils, and other environmental conditions, 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, 2015) (World Wildlife Fund, 2015). Ecoregion boundaries often coincide with physiographic[74] regions of a state. The ecoregions mapped by the USEPA are 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 USEPA Level III (USEPA, 2016i).

As shown in Figure 3.1.6-1, the USEPA divides Arizona into seven Level III ecoregions supporting a variety of different plant communities, all predicated on their general location within the state with some overlap between ecoregions. Ecological diversity is quite high in Arizona ranging from arid deserts and scrublands in the Desert Lowlands region in south and western Arizona, to semiarid shrub- and grass-covered plains in the central and eastern portions of the state, to canyonlands and volcanic plateaus in the Colorado Plateau region in the northern portion of the state, with coniferous[75] forest communities, woodlands and shrubland hills in the Colorado Plateau region as well as the eastern portion of the state. Table 3.1.6-2 provides a summary of the general abiotic[76] characteristics, vegetative communities, and the typical vegetation found within each of the seven Arizona ecoregions.

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

[71] Climate: "The average weather conditions in a particular location or region at a particular time of the year. Climate is usually measured over a period of 30 years or more." (USEPA, 2015t)

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

[73] 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)

[74] Physiographic: "The natural, physical form of the landscape." (USEPA, 2015t)

[75] Coniferous: "Cone-bearing trees, mostly evergreens, that have needle-shaped or scale-like leaves." (USEPA, 2015t)

[76] 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, 2016g)

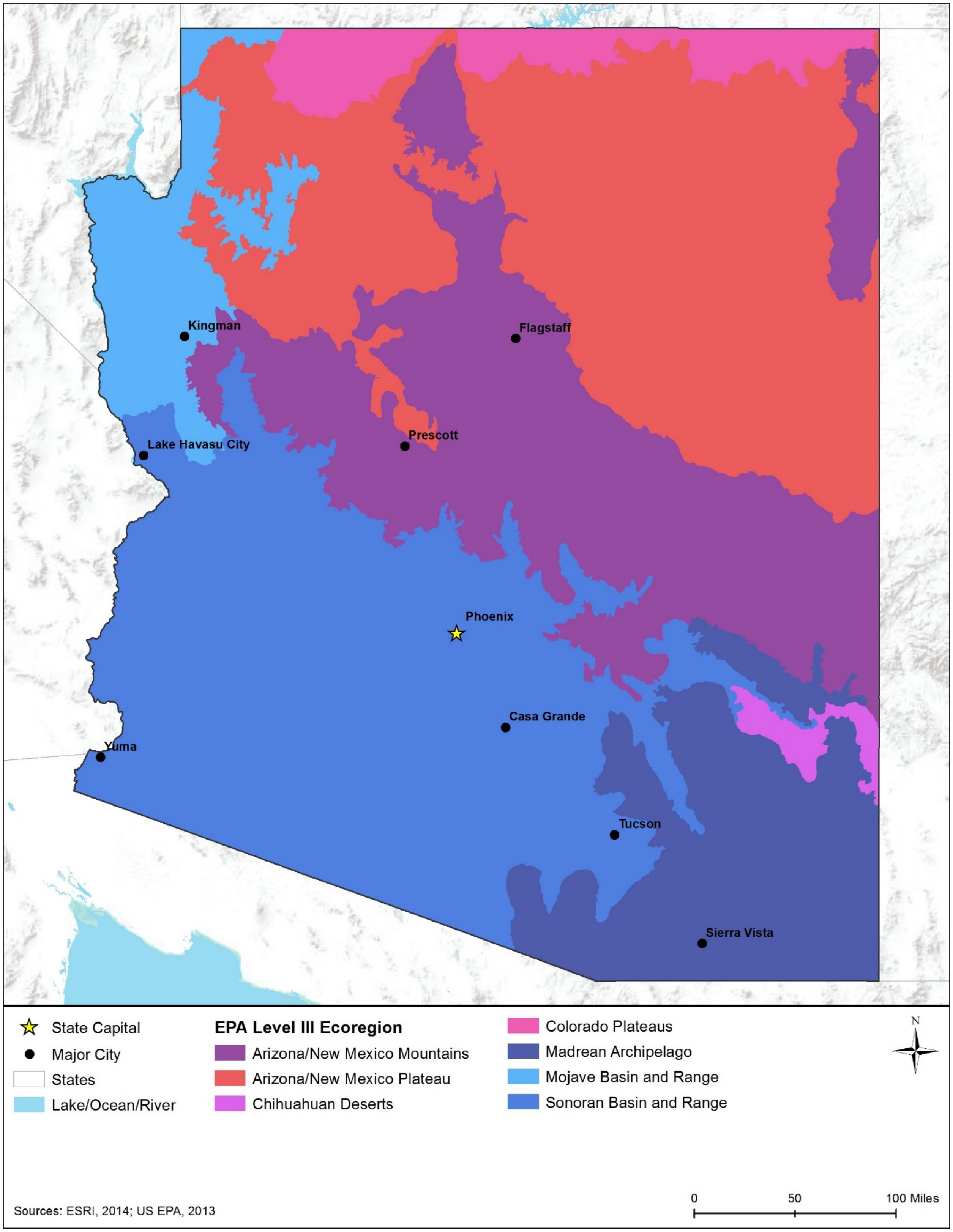

Figure 3.1.6-1: USEPA Level III Ecoregions in Arizona

Table 3.1.6-2: USEPA Level III Ecoregions of Arizona

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
Geographic Region: Colorado Plateau				
20	Colorado Plateaus	A rugged tableland topography containing varying mesas, benches, narrow canyons, and cliffs, with precipitous side-walls marking abrupt changes in local relief (often 1,000 to 2,000 feet or more). Annual precipitation averages typically range from 8 to 13 inches.	Great Basin desertscrub, Plains and Great Basin grassland, Great Basin conifer woodland	• **Shrubs and Cacti** – Big sagebrush (*Artemisia tridentata*), Bigelow sagebrush (*Artemisia bigelovii*), Winterfat (*Krascheninnikovia lanata*), Mormon tea (*Ephedra* spp.), Fourwing saltbush (*Atriplex canescens*), Shadscale (*Atriplex confertifolia*), Antelope bitterbrush (*Purshia tridentata*), Rabbitbrush (*Chrysothamnus* spp.), Buckwheat (*Eriogonum* spp.) • **Trees** – Utah juniper (*Juniperus utahensis*), Pinyon pine (*Pinus edulis*), Gambel oak (*Quercus gambelii*), Cottonwood (*Populus deltoids*, *P. fremontii*), Willow (*Salix* spp.), Ash (*Fraxinus* spp.), Tamarisk (*Tamarix* sp.), Russian olive (*Elaeagnus angustifolia*) • **Grasses** – Galleta (*Pleuraphis* sp.), Indian ricegrass (*Achnatherum hymenoides*), Blue grama (*Bouteloua gracilis*), Sand dropseed (*Sporobolus cryptandrus*), Gyp dropseed (*Sporobolus nealleyi*)
22	Arizona/New Mexico Plateau	Somewhat rugged terrain of mesas, plateaus, canyons, and rolling uplands, with local relief varying from a few feet to well over 1000 feet along tableland side slopes. A large, transitional region between the drier, higher relief tablelands to the north; lower, hotter regions to the west; semiarid grasslands to the east; and forested mountains to the northeast and south. Average annual precipitation typically ranges from 7 to 15 inches.	Great Basin desertscrub, Mojave desesrtscrub, Plains and Great Basin grassland, Great Basin conifer woodland, Montane conifer forest, Alpine conifer forest	• **Shrubs and Cacti** – Big sagebrush, Snowberry (*Symphoricarpos* sp.), Utah serviceberry (*Amelanchier utahensis*), Cliffrose (*Purshia* spp.), Shadscale, Fourwing saltbush, Greasewood (*Sarcobatus vermiculatus*), Mormon tea, Rabbitbrush, Antelope bitterbrush, Broom snakeweed (*Gutierrezia sarothrae*) • **Trees** – Utah juniper, Pinyon pine, Gambel oak, Tamarisk, Cottonwood, Willow, Ponderosa pine (*Pinus ponderosa*) • **Grasses** – Muttongrass (*Poa fendleriana*), Blue grama, Indian ricegrass, Alkali sacaton (*Sporobolus airoides*), Galleta, Black grama (*Bouteloua eriopoda*), Western wheatgrass (*Pascopyrum smithii*), Needleandthread (*Hesperostipa comata*), Sand dropseed

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
23	Arizona/New Mexico Mountains	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 and 25 inches, but varies widely within this ecoregion.	In the Colorado Plateau geographic region of Arizona: Plains and Great Basin grassland, Subalpine grassland, Great Basin conifer woodland, Montane conifer forest, Alpine conifer woodland, Tundra	• **Shrubs and Cacti –** Mountain mahogany (*Cercocarpus montanus*), Snowberry, Currant (*Ribes* sp.), Stansbury cliffrose (*Purshia stansburiana*), Big sagebrush, Black sagebrush (*Artemisia nova*) • **Trees** – Ponderosa pine, Rocky Mountain juniper (*Juniperus scopulorum*), One-seed juniper (*J. monosperma*), Utah Juniper, Blue spruce (*Picea pungens*), Engelmann spruce (*Picea engelmannii*), Gambel oak, Quaking aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*), Corkbark fir (*Abies lasiocarpa*), White fir (*A. concolor*) • **Grasses** – Arizona fescue (*Festuca arizonica*), Blue grama, Sideoats grama (*Bouteloua curtipendula*), Mountain muhly (*Muhlenbergia montana*), Mountain junegrass (*Koeleria macrantha*), Muttongrass
Geographic Region: Central Highlands				
23	Arizona/New Mexico Mountains	Distinct from other mountainous ecoregions in the vicinity by 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 and 25 inches, but varies widely within this ecoregion.	In the Central Highlands geographic region of Arizona: Plains and Great Basin grassland, Semidesert grassland, Subalpine grassland, Interior Chaparral, Madrean[77] woodland, Montane conifer forest	• **Shrubs and Cacti –** Mountain mahogany, Snowberry, Currant, Stansbury cliffrose, Sagebrush (*Artemisia* spp.), Turbinella oak (*Quercus turbinella*), Manzanita (*Arcostaphylos* spp.), Apache plume (*Fallugia paradoxa*), Fourwing saltbush, Agave (*Agave* spp.), Yucca (*Yucca* spp.), Sotol (*Dasylirion wheeleri*), Snakeweed (*Gutierrezia* spp.), Catclaw acacia (*Senegalia greggii*), Skunkbush sumac (*Rhus trilobata*), Silktassel (*Garrya* spp.), Canotia (*Canotia holacantha*), Jojoba (*Simmondsia chinensis*) • **Trees** – Ponderosa pine, Rocky Mountain juniper, One-seed juniper, Utah Juniper, Douglas-fir, Blue spruce, Gambel oak, Emory oak (*Quercus*

[77] Madrean refers to the region including the Sierra Madre Occidental of Mexico and its montane outliers in the southwestern United States.

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
				emoryii), Gray oak (*Quercus grisea*), Engelmann spruce, Blue spruce, Quaking aspen, Corkbark fir, White fir, Mesquite (*Prosopis* sp.) • **Grasses** – Arizona fescue, Blue grama, Sideoats grama, Mountain muhly, Mountain junegrass, Muttongrass, Galleta, Black grama, Needleandthread, Plains lovegrass (*Eragrostis intermedia*), Threeawn (*Aristida* spp.)
Geographic Region: Desert Lowlands				
14	Mojave Basin and Range	Terrain consists of broad basins and scattered mountains that are generally lower, warmer, and drier than adjacent regions. Average annual precipitation typically ranges from 5 to 11 inches.	Mojave desertscrub, Great Basin desertscrub	• **Shrubs and Cacti –** Creosotebush (*Larrea tridentata*), White bursage (*Ambrosia dumosa*), Brittlebush (*Encelia farinose*), Pricklypear (*Opuntia* spp.), Cholla (*Cylindropuntia* spp.), Yucca, Mormon tea, Blackbrush (*Coleogyne ramosissima*), Winterfat, Spiny menodora (*Menodora spinescens*), Beavertail cactus (*Opuntia basilaris*), Turbinella oak, Desert ceanothus (*Ceanothus greggii*), Manzanita • **Trees** – Joshua tree (*Yucca brevifolia*), Tamarisk, Paloverde (*Parkinsonia* spp.), Mesquite, Willows, Singleleaf pinyon (*Pinus monophylla)*, Gambel oak • **Grasses** – Big galleta (*Pleuraphis rigida*), Bush muhly (*Muhlenbergia porteri*), Indian ricegrass, Saltgrass (*Distichlis spicata*), Alkali sacaton
81	Sonoran Basin and Range	Terrain consists of scattered low mountains and broad basins similar to the Mojave Basin and Range and is generally hotter. "Winter rainfall decreases from west to east while summer rainfall decreases from east to west." Average annual precipitation ranges from 3 to 9 inches.	Lowland Sonoran desertscrub, Upland Sonoran desertscrub, Mojave desertscrub, Interior chaparral	• **Shrubs and Cacti** – Ephedra, White bursage, Desert buckwheat (*Eriogonum deserticola*), Creosotebush, Saltbush, Brittlebush, Cholla, Range ratany (*Krameria erecta*), Ocotillo (*Fouquieria splendens*), Barrel cactus (*Ferocactus* spp.), Beavertail cactus, Fourwing saltbush, Wolfberry (*Lycium* spp.), Globe mallow (*Sphaeralcea* spp.), Triangleleaf bursage (*Ambrosia deltoidea*), Catclaw acacia • **Trees** – Saguaro (*Carnegiea gigantea*), Mesquite, Paloverde, Tamarisk, Willow, Cottonwood, Ironwood (*Olneya tesota*), Smoke tree

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Dominant Vegetation
				(*Psorothamnus spinosus*), Desert willow (*Chilopsis linearis*) • **Grasses** – Big galleta, California threeawn (*Aristida californica*), Bush muhly, Six weeks grama (*Bouteloua barbata*), Fluffgrass (*Dasyochloa pulchella*)
79	Madrean Archipelago	Also referred to as the “Sky Islands” (biogeographical islands), this region exhibits medium to high terrain relief, typically 3000 to 5000 feet. Considered both a barrier and bridge between the Rocky Mountains and Sierra Madre Occidental ranges. Influenced by desert and mid-continental prairie biogeography, resulting in high species richness and endemism. Annual rainfall typically averages between 11 to 26 inches, with strong monsoonal influence.	Upland Sonoran desertscrub, Chihuahuan desertscrub, Plains and Great Basin grassland, Semidesert grassland, Interior chaparral, Madrean woodland, Montane conifer forest	• **Shrubs and Cacti** – Yucca, Sotol, Ocotillo, Agave, Creosotebush, Mormon tea, Mimosa (*Mimosa* spp.), New Mexico locust (*Robinia neomexicana*), Saltbush (*Atriplex* spp.) • **Trees** –Oaks (Emory, Gambel, Silverleaf [*Quercus hypoleucoides*], Netleaf [*Q. rugosa*], Toumey [*Q. toumeyi*], Arizona white [*Q. arizonica*]), Pinyon pine, Arizona madrone (*Arbutus arizonica*),Arizona cypress (*Hesperocyparis arizonia*), Cottonwood, Sycamore (*Platanus wrightii*), Willow, Apache pine (*Pinus engelmannii*), Ponderosa pine, Douglas-fir • **Grasses** – Black grama, Tobosa (*Pleuraphis mutica*), Sideoats grama, Cane beardgrass (*Bothriochloa barbinodis*), Plains lovegrass, Curly mesquite (*Hilaria belangeri*), Bush muhly, Blue grama, Alkali sacaton
24	Chihuahuan Deserts	The northernmost portion of the southernmost desert in North America and extends 500 miles south into Mexico. Exhibits a general pattern of alternating mountains and valleys. Except for a few large rivers, the landscape is largely internally draining. Historical grazing pressure may have influenced the gradual desertification of this region. Average annual precipitation ranges 9 to 14 inches.	Chihuahuan desertscrub, Upland Sonoran desertscrub, Semidesert grassland	• **Shrubs and Cacti** – Creosotebush, Fourwing saltbush, Pricklypear, Catclaw acacia, Sotol, Yucca, Ocotillo • **Trees** – Mesquite, Cottonwood, Arizona sycamore, Willow, Tamarisk, Junipers • **Grasses** – Black grama, Bush muhly, Tobosa, Alkali sacaton, Sand dropseed, Arizona cottontop (*Digitaria californica*)

Sources: (AZGFD, 2012a) (Fenneman, 1916) (USEPA, 2015e) (CEC, 2011)

Communities of Concern

Arizona contains a highly diverse assortment of vegetative communities throughout the large, topographically complex area that is comprised of the state. Wildlife rely upon the variability of all habitat types in the state, therefore the AZGFD has identified all habitat types as "inherently valuable to the natural heritage of Arizona and worthy of conservation actions" (AZGFD, 2012a). As a result, Arizona does not currently specifically identify vegetation communities of concern. Rather, the AZGFD acknowledges that some habitats may have differing values of importance, based on factors such as presence of or use by species of greatest conservation need (SGCN), economic implications, exceptionally important habitat (riparian habitats), recreational opportunities, and unfragmented habitat areas; according to the Arizona State Wildlife Action Plan, there are 531 SGCN in Arizona, which are discussed in greater detail in sections 3.1.6.4, Terrestrial Wildlife, and 3.1.6.5, Fisheries and Aquatic Habitat, below (AZGFD, 2012a). To incorporate these values and help identify conservation activities and opportunities in the future, the AZGFD has created the Heritage Data Management System (HDMS) and Project Evaluation Program (PEP), an online environmental review tool with data layers such as the Species and Habitat Conservation Guide[78] (AZGFD, 2014). A ranking system provides an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these habitats or wildlife species to potential disturbances. This ranking system also gives an indication of the level of potential impact to a particular community[79] or species that could result from implementation of an action. (AZGFD, 2013a)

Riparian vegetation habitats are acknowledged in the Arizona State Wildlife Action Plan[80] and Species and Habitat Conservation Guide model as especially important habitats based on their roles in ecological function and wildlife value, including wildlife sustainability, wildlife movement corridors, productivity, aquifer recharge, surface water quality, floodwater control, and ecological diversity (AZGFD, 2012a). The Species and Habitat Conservation Guide specifically included riparian, wet, and xeric riparian habitats as weighting factors for wildlife conservation potential.

While Arizona does not specifically identify vegetation communities of concern, individual plant species are evaluated for rarity. In addition, 22 plant species are threatened or endangered in Arizona. Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these species.

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive 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.

[78] Arizona's Species and Habitat Conservation Guide is a data layer on AZGF HabiMap, http://www.habimap.org/habimap/.
[79] Community: "In ecology, an assemblage of populations of different species within a specified location in space and time. Sometimes, a particular subgrouping may be specified, such as the fish community in a lake or the soil arthropod community in a forest." (USEPA, 2015t)
[80] The Arizona State Wildlife Action Plan is available at the following website: https://www.azgfd.com/wildlife/actionplan/.

Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (GPO, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. 7701 *et seq.*). As of June 2016, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) of which 7 species are known to occur in Arizona (3 terrestrial, 1 aquatic, and 3 parasitic) (USDA, 2016a).

Noxious weeds are a threat to Arizona's rangeland,[81] cropland, pastureland,[82] wildlands, and riparian habitats. Noxious weeds can have adverse ecological and economic impacts to these resources by displacing native species, degrading wildlife habitat, and impacting agriculture (University of Arizona Cooperative Extension, 2015). The Arizona Noxious Weed Law (ARS §3-201 *et seq.*) stipulates that the ADA be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. The Act further stipulates that the ADA is responsible for implementing and enforcing noxious weed management. In addition, individual districts within a county may organize an antinoxious weed district for the purposes of eradication and control of noxious weed species within their district, as defined by the ADA noxious weed species list (ARS §48-301 *et seq.*). The ADA regulates noxious weeds within the state under three categories: species that are prohibited from entry into the state; species that are regulated and if found within the state may be controlled or quarantined to prevent further infestation; and restricted species that if found within the state shall be quarantined to prevent further infestation. (USDA, 2016b)

Fifty-four noxious prohibited, regulated, or restricted plants are regulated in Arizona, as set forth in the ARS §3-201. Of these species, 48 are terrestrial and 6 are aquatic species (ADA, 2006). The following species by vegetation type are regulated in Arizona:

- **Aquatic –** alligatorweed (*Alternanthera philoxeroides*), anchored water hyacinth (*Eichhornia azurea*), floating water hyacinth (*E. crassipes*), hydrilla (*Hydrilla verticillata*), giant salvinia (*Salvinia molesta*), water-chestnut (*Trapa natans*).
- **Shrubs –** Sweet resinbush (*Euryops multifidus*)
- **Terrestrial Forbs and Grasses –** puna grass (*Achnatherum brachychaetum*), Russian knapweed (*Acroptilon repens*), jointed goatgrass (*Aegilops cylindrica*), camelthorn (*Alhagi maurorum*), lens podded hoary cress (*Cardaria chalepensis*), globe-podded hoary cress (*C. draba*), hairy whitetop (*C. pubescens*), plumeless thistle (*Carduus acanthoides*), Southern sandbur (*Cenchrus echinatus*), field sandbur (*C. incertus*), purple starthistle (*Centaurea calcitrapa*), diffuse knapweed (*C. diffusa*), Iberian starthistle (*C. iberica*), yellow starthistle (*C. solstitialis*), spotted knapweed (*C. stoebe* ssp. *macranthos*), Sicilian starthistle (*C. sulphurea*), squarrose knapweed (*C. virgata* ssp. *squarrosa*), rush skeletonweed (*Chondrilla juncea*), Canada thistle (*Cirsium arvense*), field bindweed (*Convolvulus arvensis*), creeping wartcress (*Coronopus squamatus*), dudaim melon (*Cucumis melo*), dodder (*Cuscuta* spp.),

[81] Rangeland: "A Land cover/use category on which the climax or potential plant cover is composed principally of native grasses, grasslike plants, forbs or shrubs suitable for grazing and browsing, and introduced forage species that are managed like rangeland." (USEPA, 2015t)
[82] Pastureland: "Land used primarily for the production of domesticated forage plants for livestock." (USEPA, 2015t)

alfombrilla (Lighteningweed) (*Drymaria arenarioides*), quackgrass (*Elymus repens*), leafy spurge (*Euphorbia esula*), halogeton (*Halogeton glomeratus*), Texas blueweed (*Helianthus ciliaris*), morning glory (*Ipomoea* spp., including *I. triloba*), dyers woad (*Isatis tinctoria*), Dalmatian toadflax (*Linaria dalmatica* ssp. *dalmatica*), purple loosestrife (*Lythrum salicaria*), burclover (*Medicago polymorpha*), serrated tussock (*Nassella trichotoma*), Scotch thistle (*Onopordum acanthium*), branched broomrape (*Orobanche ramosa*), torpedo grass (*Panicum repens*), African rue (*Peganum harmala*), buffelgrass (*Pennisetum ciliare*), common purslane (*Portulaca oleracea*), Austrian fieldcress (*Rorippa austriaca*), tansy ragwort (*Senecio jacobaea*), Carolina horsenettle (*Solanum carolinense*), tropical soda apple (*S. viarum*), perennial sowthistle (*Sonchus arvensis*), witchweed (*Striga* sp.), puncturevine (*Tribulus terrestris*). (USDA, 2016b)

3.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Arizona, divided among mammals,[83] birds,[84] reptiles and amphibians,[85] and invertebrates.[86] Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers,[87] nongame animals, game birds, waterfowl, and migratory birds as well as their habitats within Arizona. 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. According to the AZGFD, the state is home to 224 mammal species, 590 documented bird species, 197 reptile species, 38 amphibian species, and 1,239 invertebrate species[88] (AZGFD, 2016a).

The Arizona Natural Heritage Program Heritage Data Management System (HDMS) is a statewide inventory that includes lists of all types of wildlife species known to occur, or that have historically occurred, in the state (AZGFD, 2015a). Historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Information from the HDMS is used to establish the SGCN list, which consists of at-risk species that are rare or declining. State Wildlife Grants can provide funding for efforts to reduce their potential to be listed as endangered. Although these species have been targeted for conservation they are not currently under legal protection. The SGCN list is updated periodically and is used by the state to focus their conservation efforts and as a basis for implementing their SWAP.

[83] 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, 2015t)
[84] Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves." (USEPA, 2015t)
[85] 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, 2015t)
[86] Invertebrates: "Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015t)
[87] Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.
[88] The AZGFD list contains both terrestrial and aquatic invertebrate species (AZGFD, 2016a).

Mammals

Two hundred twenty four mammal species occur in Arizona. Common and widespread mammalian species in Arizona include the mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), and mountain lion (*Puma concolor*). Most mammals are widely distributed in the state; however, there are some species, such as the bighorn sheep (*Ovis canadensis*) or kit fox (*Vulpes macrotis*) that are restricted to desert portions of the state or black bear (*Ursus americanus*) and elk (*Cervus canadensis*) that are restricted to mountainous portions in the north-central and eastern portions of the state. The AZGFD has identified 93 mammal SGCN, eight of which are also considered federally threatened or endangered (AZGFD, 2012a). Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Arizona white-tailed deer (*Odocoileus virginianus*), mule deer, elk, antelope *(Antilocapra Americana)*, bighorn sheep, buffalo (*Bison bison*), javelina *(Dicotyles tajacu)*, black bear, and mountain lion are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits) and upland and migratory game birds (AZGFD, 2012a) (AZGFD, 2015b). The following seven species of furbearers may be legally hunted or trapped in Arizona: badger (*Taxidea taxus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), otter (*Lontra canadensis*), raccoon (*Procyon lotor*), ringtail (*Bassariscus astutus*), and weasel (*Mustela* spp.). Nine species of predator may also be legally hunted or trapped in Arizona: bobcat (*Lynx rufus*), coyote (*Canis latrans*), three species of fox (*Vulpes* spp.), and four species of skunk *(Mephitidae* spp.) (AZGFD, 2016b) (AZGFD, 2016c).

Birds

The number of native bird species documented in Arizona varies according to the timing of the data collection effort, changes in bird taxonomy,[89] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., mountains, canyons, desert lands, grasslands, forests, lakes, rivers and playas, etc.) and climate zones[90] found in Arizona support a large variety of bird species.

Currently, 590 species of resident and migratory birds have been documented in Arizona, with 283 of those species confirmed as breeding in the state (AZGFD, 2016a)(AZGFD, 2005). Among the 590 extant[91] species in Arizona, 145 SGCN have been identified (AZGFD, 2012a). Eight threatened, endangered, and candidate bird species and critical habitat for some of these species are located in Arizona and are identified in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Arizona is located within the Pacific Flyway, which spans from the west coast of Mexico to the arctic. Large numbers of migratory birds utilize this flyway and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. Neotropical bird species are those that breed in the U.S. or Canada

[89] Taxonomy: "A formal representation of relationships between items in a hierarchical structure" (USEPA, 2015t).
[90] More information on climate zones, or climate classes, is in Section 3.1.14, Climate Change.
[91] Extant: "A species that is currently in existence (the opposite of extinct)." (USEPA, 2015t)

and winter in Mexico or South America. In Arizona, 237 neotropical migrant species have been documented, 163 of which are been documented as nesting in the state (AZGFD, 2016d). The Migratory Bird Treaty Act (MBTA) makes it "illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to Federal regulations" (USFWS, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers, lakes, and streams in Arizona throughout the year, with bald eagles migrating to Arizona from the north in the winter. Golden eagles have been observed in Arizona, generally nesting in mountains and cliffs. In Arizona, limited information is available related to total numbers and preferred habitats (AZGFD, 2016e).

A number of Important Bird Areas (IBAs) have also been identified in Arizona. 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.

According to the Arizona Audubon Society, a total of 45 IBAs have been identified in Arizona, including breeding,[92] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, biogeographical "sky islands", high elevation pine forest, desert, rivers, canyons, and wetland/riparian[93] areas (Arizona Audubon Society, 2015). These IBAs, which cover approximately 4.5 million acres, are widely distributed throughout the state, although the largest concentration of IBAs are located along rivers in the southeastern portion of the state. The Sonoran Desert Borderlands is the largest IBA in Arizona, covering almost 1.1 million acres in Yuma and Pina counties (Arizona Audubon Society, 2011). Figure 3.1.6-2 depicts the IBAs of Arizona.

Reptiles and Amphibians

A total of 197 reptile and 38 amphibian species occur in Arizona, consisting of 14turtles, 81 lizards, 102 snakes, 19 frogs, 15 toads, and 4 salamanders (AZGFD, 2016a). Arizona is home to six non-native reptile species (e.g., red-eared slider (*Trachemys scripta elegans*), a species of pond slider, and four exotic amphibians (bullfrogs [*Lithobates catesbeianu*], Rio Grande leopard

[92] 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, 2015t)
[93] 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, 2015t)

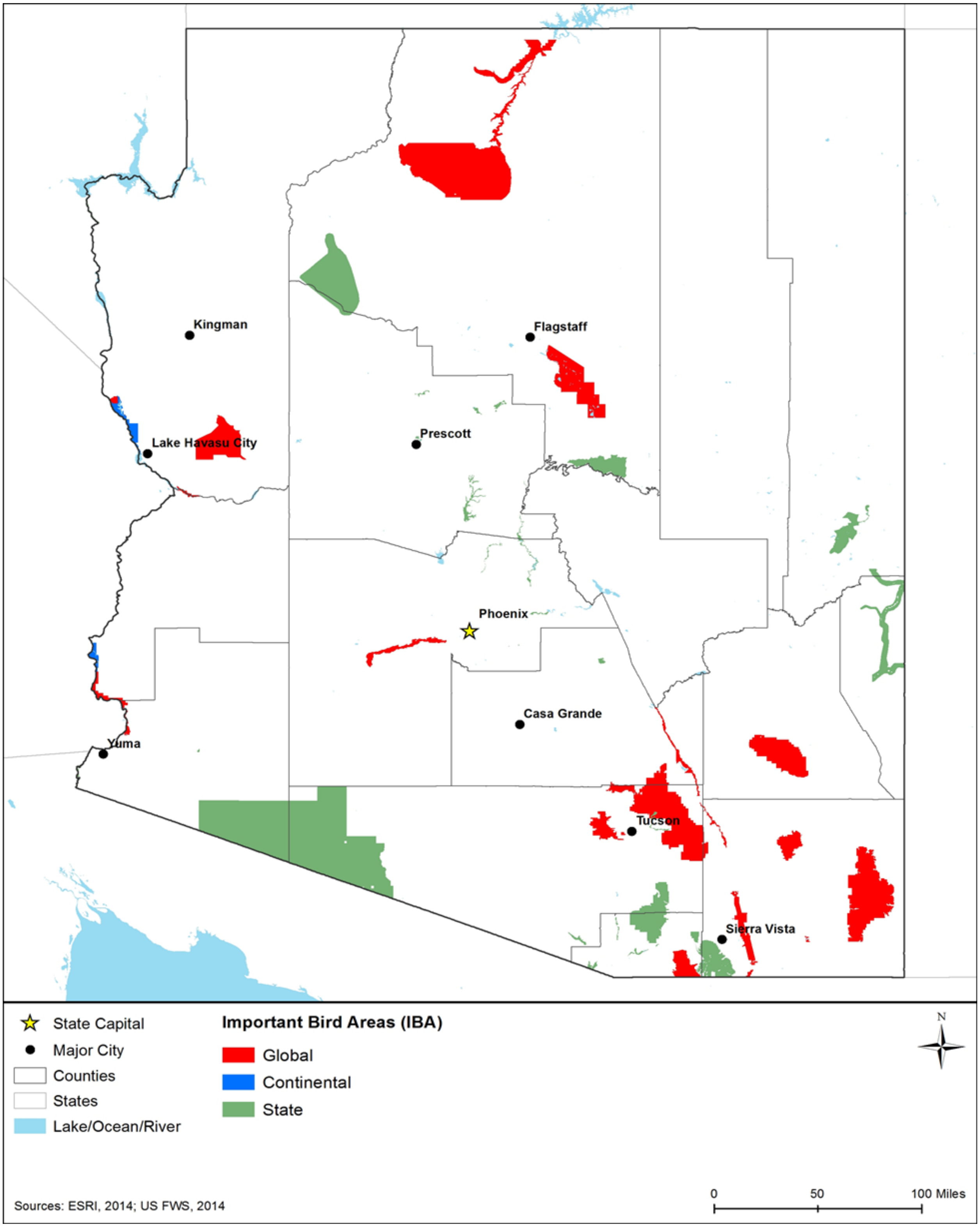

Figure 3.1.6-2: Important Bird Areas in Arizona

frogs [*Rana berlandieri*], African clawed frogs [*Xenopus laevis*], and barred tiger salamanders [*Ambystoma mavortium*]) (AZGFD, 2013b). Reptiles are found nearly everywhere in Arizona in each type of vegetation community. Many species are widespread, but a few, such as the spotted turtle (*Clemmys guttata*), are found in specific habitats such as riparian areas or cienegas. Of the 235 reptile and amphibian species, 73 SGCN have been identified (AZGFD, 2012a). Several threatened and endangered reptile and amphibian species occur in Arizona, as well as designated critical habitat, and are identified in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Invertebrates

In general, invertebrate species are poorly described and documented, resulting in an incomplete ecological understanding of this group of species. As of January 2016, the list of invertebrate species known to occur in Arizona developed by the AZGFD consists of 1,239 terrestrial and aquatic invertebrates (AZGFD, 2016a). Common terrestrial invertebrate species in Arizona include a wide variety of bees, wasps, ants, butterflies, moths, grasshoppers, beetles, flies, dragonflies, damselflies, spiders, scorpions, termites, mites, and nematodes. These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. In the U.S., one third of all agricultural output depends on pollinators.[94] In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009).

The AZGFD has identified nine terrestrial mollusk SGCN within Tiers 1A and 1B,[95] which are snail and slug species (AZGFD, 2016a). One federally listed terrestrial invertebrate species is known to occur in Arizona, the Kanab ambersnail (*Oxyloma haydeni kanabensis*), and is discussed in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Invasive Wildlife Species

Arizona has not adopted official rules regarding invasive wildlife species. The Arizona Invasive Species Advisory Council and AZGFD have presented information on select wildlife species considered invasive in Arizona. Terrestrial wildlife species include red imported fire ants, bullfrog, and Asian tiger mosquito. 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

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

[95] Arizona assigns status tiers to species on the SGCN. Tiers 1A and 1B scored a "1" for Vulnerability (scoring methodology is in the SWPP at https://www.azgfd.com/PortalImages/files/wildlife/2012-2022_Arizona_State_Wildlife_Action_Plan.pdf). Tier 1A species are also a federally listed, a candidate for listing, or recently delisted species under the ESA, specifically covered under a conservation agreement, or identified by the Arizona Game and Fish Commission as a closed season (no take) species. Tier 1C species, the majority of invertebrate species identified in the SWPP as SGCN, are unable to be assessed as not enough data is available to assess species status and have been identified as a research need. Tier 1C species are reevaluated when more information becomes available. (AZGFD, 2015i)

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.

3.1.6.5. Fisheries and Aquatic Habitats

This section discusses the aquatic wildlife species in Arizona, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Arizona landscape with regard to aquatic wildlife is the limited overall amount of aquatic habitat that includes a small number of large rivers, large reservoirs, and a variety of springs, streams, cienegas, lakes, and ephemeral water features. As of January 2016, the AZGFN identified 111 fish species in the state (AZGFD, 2016a). No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in Arizona. Critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Arizona and is discussed in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

Fish communities in Arizona follow a roughly defined distribution among two general habitat types: habitats along the Colorado River and several smaller rivers such as the Little Colorado, Salt, Gila, San Pedro, Bill Williams and Santa Maria rivers, and those of small springs, mountain streams, headwater streams of larger rivers, lakes, and ponds, and isolated desert waters. Fish species of the larger rivers and reservoirs include native species such as bluehead sucker (*Catostomus discobolus yarrow*), bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), and speckled dace (*Rhinichthys osculus*), and game species such as largemouth bass (*Micropterus salmoides*), catfish, striped bass (*Morone saxatilis*), crappie (*Pomoxis* spp.), and trout, among others. Species found in spring and small stream habitats as well as smaller lakes and cienegas include Apache trout (*Oncorhynchus apache*), Gila trout (*Oncorhynchus gilae*), desert pupfish (*Cyprinodon macularius*), desert sucker (*Catostomus clarkii*), Gila chub (Gila intermedia), headwater chub (*Gila nigra*), Little Colorado spinedace (*Lepidomeda vittata*), Little Colorado sucker (*Catostomus* sp. 3), loach minnow (*Rhinichthys cobitis*), Gila topminnow (*Poeciliopsis occidentalis*), and spikedace (*Meda fulgida*), as well as game species such as trout, walleye (*Sander vitreus*), crappie, bass, bluegill (*Lepomis macrochirus*), and catfish. Some fish species use both habitat types (for example but not limited to trout, crappie, and bass), but most tend to occur in one of the two general habitat types.

The salmon family is considered a very important fish family in the U.S. for many reasons, including commercial and recreational fishing value, their role in aquatic and terrestrial ecosystems, and their role in fisheries management. In Arizona the salmon family is represented by two native species, Apache (*Oncorhynchus apache*) and Gila trout (*Oncorhynchus gilae*), as well as introduced game fish species, all of which tend to occur in headwater streams and rivers in the mountainous or upper elevation areas within the state. Both Apache and Gila trout are considered SGCN and occur in perennial headwater mountainous streams and rivers in the White Mountains region of east-central Arizona, and have been introduced in several streams in central and northern Arizona (AZGFD, 2001a) (AZGFD, 2015c). Brook trout (*Salvelinus fontinalis*) are stocked in the White Mountains and lakes and streams on the Apache Reservation in the east-central portion of the state. These trout species utilize gravel pools within headwater streams for spawning and nursery habitat. Ideal spawning habitat requires riverbeds with rapidly flowing water with good gravel substrate.

Freshwater fish and associated freshwater habitats are considered one of the most highly threatened ecosystems based on the decline in species population numbers. Approximately 40 percent of fish species in North America are considered at risk or vulnerable to extinction[96] (National Fish Habitat Board, 2010) (USFWS, 2015d). Major threats to freshwater fisheries include habitat modification and destruction (dams, culverts, weirs, urban development, and agricultural practices), overfishing, invasive species, and environmental pollution and impaired water quality. Desert fish species native to the southwestern U.S., including Arizona, are predominantly endemic to the region and are highly adapted to the unique desert conditions in which they inhabit (National Fish Habitat Board, 2010). Native fish species in Arizona are considered to be the most threatened by habitat loss and degradation[97] resulting largely from urbanization, water diversion, and loss through damming of rivers and irrigation, overgrazing, introduced fishes, and drought. Salmonid and other fishes often outcompete and prey upon native desert fish, or in the case of native trout can interbreed and reduce the numbers of purebred native species (National Fish Habitat Board, 2010). Aquatic habitats have been largely altered as a result of water diversion projects, resulting in changes to major habitat constituents such as water temperature, seasonal flow regime, and sediment levels, among other factors.

Shellfish and Other Invertebrates

As of January 2016, the list of invertebrate species known to occur in Arizona developed by the AZGFD consists of 1,239 terrestrial and aquatic invertebrates (AZGFD, 2016a). Aquatic species are snails, insects, fairy shrimp, grass shrimp, amphipods, one leech species, and one native freshwater mussel species. Twenty-one non-native mollusk species occur in the state, including the invasive quagga mussel (*Dreissena bugensis*) and New Zealand mudsnail (*Potamopyrgus antipodarum*). Very little is known about most of the species in Arizona, with many species assumed to be endemic to the state, occurring often in isolated springs, rock slides, and other undeveloped areas (AZGFD, 2015d).

Arizona has classified 18 aquatic invertebrates as Tier 1A and 1B SGCN[98] (AZGFD, 2016a). Two aquatic invertebrates are federally listed and are identified in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

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[96] Extinction: "The disappearance of a species from part or all of its range." (USEPA, 2015t)
[97] Degradation: "The reduction of the capacity of the environment to meet social and ecological objectives, and needs. Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards." (USEPA, 2015t)
[98] Arizona assigns status tiers to species on the SGCN. Tiers 1A and 1B scored a "1" for Vulnerability (scoring methodology is in the SWPP at https://www.azgfd.com/PortalImages/files/wildlife/2012-2022_Arizona_State_Wildlife_Action_Plan.pdf). Tier 1A species are also a federally listed, a candidate for listing, or recently delisted species under the ESA, specifically covered under a conservation agreement, or identified by the Arizona Game and Fish Commission as a closed season (no take) species. Tier 1C species, the majority of invertebrate species identified in the SWPP as SGCN, are unable to be assessed as not enough

Invasive Aquatic Species

As previously discussed, Arizona has adopted regulations that prohibit or regulate the possession, transport, importation, sale, purchase and introduction of select invasive species, both plants and animals. AZGFD maintains a list of aquatic invasive species for Arizona, designation of locations where listed aquatic invasive species are known to occur, and mandatory conditions for movement of watercraft, vehicles, and equipment in order to abate, eradicate, or prevent the spread of listed aquatic invasive species. These lists are presented in Arizona Administrative Register – AZGFD Director's Orders 1, 2, and 3, respectively.[99] The list of aquatic invasive species includes 4 mollusks, 2 crustaceans, 4 fish, and 1 alga, 1 plant, 1 parasite, and 1 virus. Aquatic invasive species that have been detected in Arizona include the quagga mussel, zebra mussel, New Zealand mudsnail, didymo (*Didymosphenia geminate*), giant salvinia (*Salvinia molesta*), apple snails, whirling disease, and largemouth bass virus (AZGFD, 2015e).

3.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

The USFWS is responsible for administering the ESA (16 U.S.C §1531 et seq.) in Arizona. The USFWS Office has identified 44 federally endangered and 21 federally threatened species known to occur in Arizona (USFWS, 2015e). Of these, 32 have designated critical habitat[100] (USFWS, 2015e). Eleven candidate species[101] are identified by USFWS as occurring within the state (USFWS, 2015f). The 65 federally listed species include 9 mammals, 4 reptiles, 7 birds, 19 fish, 2 amphibians, 3 invertebrates, and 21 plants (USFWS, 2015e), and are discussed in detail under the following sections. Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency would be required.

Mammals

Nine endangered mammal species are federally listed for Arizona as summarized in Table 3.1.6-3. The Hualapai Mexican vole (*Microtus mexicanus hualpaiensis*) occurs in northwestern Arizona. The New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) occurs in eastern Arizona. The jaguar (*Panthera onca*) and the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*) occur in southern Arizona. The Sonoran pronghorn (*Antilocapra americana sonoriensis*) occurs in southwestern Arizona. The Mount Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*) and the ocelot (*Leopardus pardalis*) occur in southeastern Arizona.

data is available to assess species status and have been identified as a research need. Tier 1C species are reevaluated when more information becomes available. (AZGFD, 2015i)

[99] Arizona Administrative Register – Director's Order 1, 2, and 3 are at https://www.azgfd.com/PortalImages/files/fishing/InvasiveSpecies/AIS_DO.pdf.

[100] 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)).

[101] 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)

Experimental populations of the Mexican gray wolf (*Canis lupus baileyi*) occur in northeastern Arizona (USFWS, 2016a). There are both Endangered and Non-Essential Experimental populations[102] of the black-footed ferret (*Mustela nigripes*) occur in central Arizona (USFWS, 2016b). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-3: Federally Listed Mammal Species of Arizona

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Arizona	Habitat Description
Black-footed Ferret	*Mustela nigripes*	E/XN	No	Native grasslands with healthy populations of prairie dogs. Found in Coconino and Yavapai counties, central Arizona.
Gray Wolf	*Canis lupus baileyi*	E/XN	No	Grasslands, pine forests, and woodlands with adequate prey availability. Found in the portion north of the centerline of Interstate Highway 40; in 6 counties in northern Arizona.
Hualapai Mexican Vole	*Microtus mexicanus hualpaiensis*	E	No	Moist, grassy patches of pine forests in northwestern Arizona.
Jaguar	*Panthera onca*	E	Yes; in Cochise, Pima, and Santa Cruz counties, southern Arizona.	Thornscrub, deserts, semidesert grasslands, oak woodlands, and pine forests, with adequate prey availability. Found in Cochise, Pima, and Santa Cruz counties, southern Arizona.
Lesser Long-nosed Bat	*Leptonycteris curasoae yerbabuenae*	E	No	Desertscrub with flowering columnar cactus or paniculate agave for foraging. Found in 8 counties in southern Arizona.
Mount Graham Red Squirrel	*Tamiasciurus hudsonicus grahamensis*	E	Yes; in the Pinaleño Mountains, Graham County, southeastern Arizona.	Old growth stands of pine and spruce above 8,000 feet in elevation in the Pinaleño Mountains, Graham County, southeastern Arizona.
New Mexico Meadow Jumping Mouse	*Zapus hudsonius luteus*	E	Yes; along the White Mountains of Apache County, northeastern Arizona.	Nests in dry soils with riparian vegetation. Found in Apache and Greenlee counties, eastern Arizona.

[102] Experimental Populations: Reintroduced populations established outside the species' current range, but within its historical range, as designated by the Secretary of the Department of the Interior under Section 10(j) of the Endangered Species Act (USFWS, 2010d).

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Arizona	Habitat Description
Ocelot	*Leopardus pardalis*	E	No	Microhabitats with dense habitat cover. Found in 6 counties in southeastern Arizona.
Sonoran Pronghorn	*Antilocapra americana sonoriensis*	E/XN	No	Open flat terrain, with paloverdes and chain-fruit cholla associations. Found in 6 counties in southwestern Arizona.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened, XN = Non-Essential Experimental Population

Black-footed Ferret. The black-footed ferret is a member of the weasel family (*Mustelidae*); it is a long slender animal with a black markings around its eyes, black feet, and a black-tipped tail. This species ranges from 19 to 24 inches long and 1.4 to 2.5 pounds (USFWS, 2015bp). The ferret was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973 (USFWS, 2015e). There is currently no critical habitat for this species (USFWS, 2013b).

Once historically populous and ranging across the grasslands of the western United States, by 1986, only 18 individuals were known to exist within its range. The last remaining individuals in the wild were captured near Meeteetse, Wyoming, and were used to develop experimental populations in Arizona, Colorado, Montana, South Dakota, Utah, and Wyoming. In Arizona, the species historically inhabited the grasslands of the eastern portion of the state. The species has been reintroduced to two locations in Arizona: the Aubrey Valley and Espee Ranch in Coconino County (USFWS, 2013b). As of October 2014, there were an estimated 148 adult ferrets in Coconino and Yavapai counties, in the central part of the state (USFWS, 2015e).

Suitable habitat for the black-footed ferret consists of native grasslands inhabited by prairie dogs. The survival of black-footed ferrets is directly connected to prairie dog abundance and habitat, as prairie dog burrows are used for shelter as well as dens to rear their young. In addition, over 90 percent of the black-footed ferret’s diet is composed of prairie dogs. The primary causes for this species’ near extinction was the loss of habitat and prey resulting from conversion of prairies to agriculture or other uses, and prairie dog eradication programs diseases, including canine distemper and sylvatic plague, also impacted the species. (USFWS, 2010a) (USFWS, 2013b)

Gray Wolf. The gray wolf is a member of the dog (canine) family, with fur colors of white, red, brown, or black. The species reaches an approximate length of 6 feet, weighs approximately 100 pounds, and typically lives up to 5 years (USFWS, 2015g). The gray wolf was listed as endangered in 1978 (42 FR 9607 9615, March 9, 1978), and has since been divided into a number of distinct populations. It was originally listed as subspecies or regional populations throughout the United States and Mexico, but was reclassified in 1978 as an endangered population at the species level, except for in states where it is threatened or delisted. The species’ distribution ranges from Canada to the American southwest and Mexico (USFWS, 2015g). The subspecies of gray wolf that occurs in Arizona, New Mexico, and Mexico is called the Mexican gray wolf (*Canis lupus baileyi*), and is the smallest in size, southern-most, and most endangered subspecies of gray wolves occurring in North America (AZGFD, 2006). Within Arizona, it is found in the portion north of the centerline of Interstate Highway 40 in six counties (USFWS, 2015bn).

The gray wolf is known as a keystone predator, which means it is an integral component of the ecosystems to which it typically belongs. It inhabits a wide range of habitats, including temperate forests, mountains, tundra, taiga, and grasslands (USFWS, 2015g). As a top predator, it feeds on deer, elk, small mammals, and livestock. Threats to the gray wolf include habitat destruction via human population increase and expansion, potential viral or bacterial diseases, and illegal shooting (USFWS, 2015g).

Hualapai Mexican Vole. The Hualapai Mexican vole is a small, brown mammal native to northwestern Arizona (Mohave, Yavapai, and Coconino counties). It grows to approximately 5.5 inches in length and weighs an average of 28 grams (AZGFD, 2003a). Recent taxonomic disagreement may impact the vole's federal protection. Originally thought to be a distinct subspecies with a very limited range, the Hualapai Mexican vole was listed as endangered by the USFWS in 1987 (52 FR 36776 36780, October 1, 1987) with no critical habitat; however, recent studies show the Hualapai Mexican vole may not be a distinct subspecies, and may be a part of the more widespread *M. m. mogollonensis* subspecies. This has warranted a 2015 USFWS proposal delisting of the Hualapai Mexican vole (52 FR 36776 36780; June 4, 2015) (USFWS, 2015am).

The Hualapai Mexican vole's current and historic range is restricted to the mountains of northwestern Arizona (AZGFD, 2003a). It inhabits grassy habitats, typically in association with ponderosa pine (*Pinus ponderosa*). Because it requires moist environment, it is now almost entirely restricted to habitats near water sources. Threats to the Hualapai Mexican vole are its limited range and habitat alteration from livestock grazing, recreation use, and development (AZGFD, 2003a).

Jaguar. The jaguar is a species of large predatory cat native to North, Central, and South America. The species typically ranges from Mexico to southern Brazil, but its range occasionally stretches into southern portions of Arizona and New Mexico. This large, yellow and tan cat with black markings can grow up to 220 pounds as an adult (USFWS, 2012a). The jaguar was first listed as endangered by the USFWS in 1972 (37 FR 6476, March 30, 1972) and was incorporated into the ESA of 1973. Critical habitat was established for the species in 2014 (79 FR 12571 12654, March 5, 2014), in southeastern Arizona and southwestern New Mexico (Figure 3.1.6-3). In Arizona, the jaguar is found in Cochise, Pima, and Santa Cruz counties, in the southern part of the state (USFWS, 2015i).

Jaguar Photo Credit: USFWS

While more common in and south of Mexico, the jaguar historically inhabited portions of California, Arizona, New Mexico, and Texas. In Arizona, the species has been observed as far north as the Grand Canyon, but sightings of the species have been limited to the southeastern portion of the state since the 1960's. The jaguar is associated with a wide variety of habitats throughout its range. In Arizona, the species uses thornscrub, deserts, semidesert grasslands, oak woodlands, and pine forests. The rare individuals in Arizona are likely associated with larger populations in Mexico. Threats to this species' success in Arizona include habitat destruction and alteration, illegal killing, border issues, and climate change (USFWS, 2012a).

Lesser Long-nosed Bat. The lesser long-nosed bat is a medium, brown bat with a wingspan of up to 16 inches and a weight of up to 25 grams (AZGFD, 2011). Some researchers consider the lesser long-nosed bat is a subspecies of the long-nosed bat (*Leptonycteris curasoae yerbabuenae*) found in central California, southern Arizona, New Mexico, Mexico, and as far south as Honduras and El Salvador (USFWS, 2007). The species was listed by the USFWS as endangered in 1988 (53 FR 38456 38460, September 30, 1988).[103] No critical habitat has been established for the subspecies. In Arizona, it is found in eight counties in the southern portion of the state (USFWS, 2015j).

The bat occupies caves and mines as day roosts and require foraging areas with flowering columnar cactus or paniculate[104] agave. It is adapted for arid areas, often found in desert scrub habitat in their United States range and in higher elevations of wooded mountains in their southern range. Populations in the United States and northern Mexico migrate south during the fall and return north in the spring. Within Arizona, the subspecies' range extends from the Picacho Mountains southwest to the Agua Dulce Mountains and southeast to the Galiuro and Chiricahua Mountains, and south to Mexico. Additionally, there have been two late summer records of the subspecies from the Phoenix area and one from the Pinaleño Mountains. The primary threat to the subspecies is habitat destruction via removal of agaves and cactus, necessary for it to forage. (AZGFD, 2011) (USFWS, 1988)

[103] In September 2013, the USFWS issued a 90-day petition finding and initiation of status review for the lesser long-nosed bat and several other species (78 FR 55046 55051; September 9, 2013). This issuance initiated a review of the status of the bat to determine if respective actions of delisting and reclassifying are warranted. As of June 2016, the lesser long-nosed bat is listed as Endangered.

[104] Loosely branched.

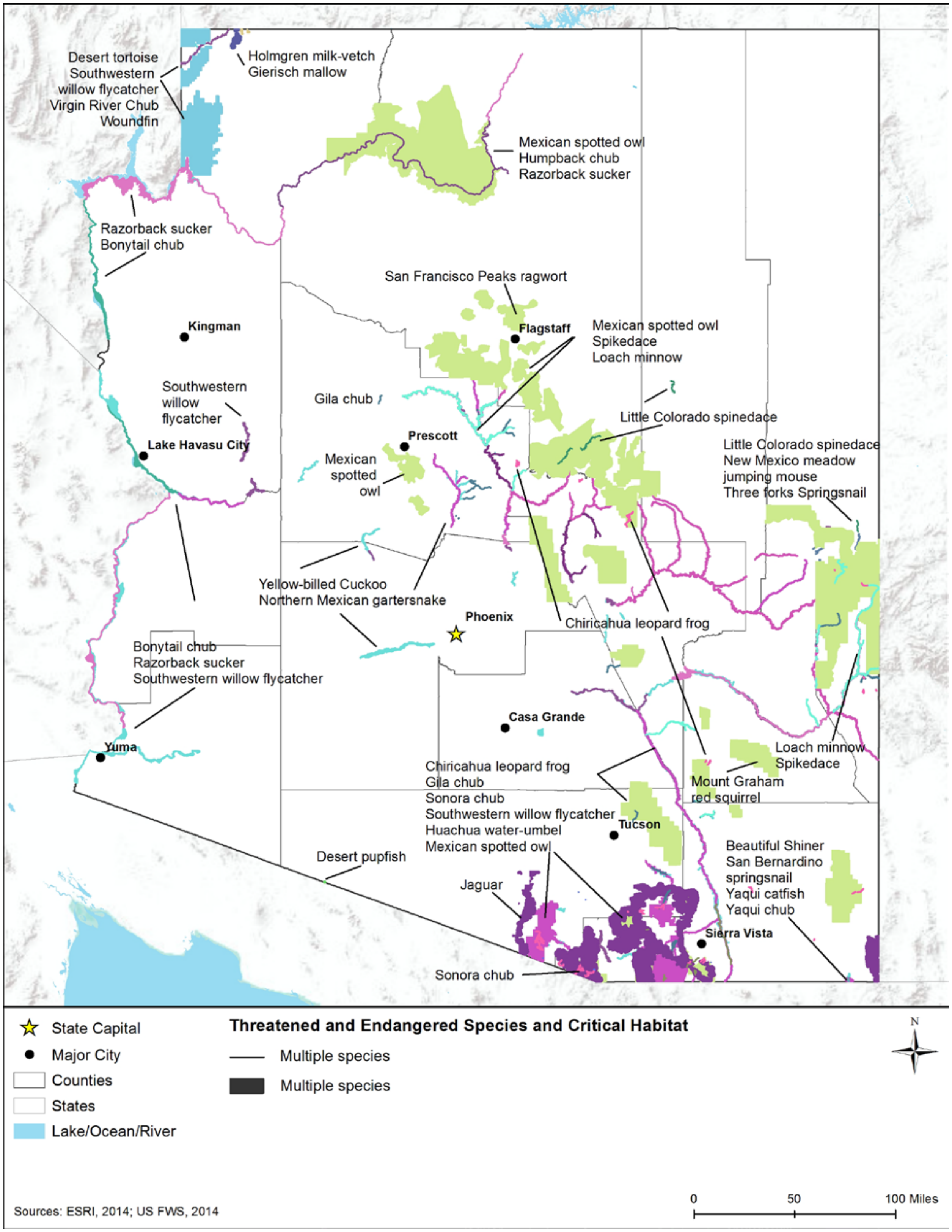

Figure 3.1.6-3: ESA Designated Critical Habitat in Arizona

Mount Graham Red Squirrel. The Mount Graham red squirrel is a subspecies of the American red squirrel (*Tamiasciurus hudsonicus grahamensis*) that is endemic to the Pinaleño Mountains of Graham County, Arizona. It is a small, grey to brown, tree-dwelling squirrel that grows to approximately 15 inches in length (USFWS, 2011a). It was federally listed as threatened in 1987 (52 FR 20994 20999, June 3, 1987) and afforded approximately 2,000 acres of critical habitat in 1990 (55 FR 425 429, January 5, 1990) in the Pinaleño Mountains, Graham County, southeastern Arizona. It can be found in Graham County, in southeastern Arizona (USFWS, 2015k).

The red squirrel is found in pine forests as one of its main food sources is conifer cones. The Mount Graham subspecies is thought to be a relic of a larger ice age population that is now restricted to isolated habitat atop the Pinaleño Mountains (Sanderson, Kaprowski, 2009). Within its home range, the Mount Graham red squirrel occupies old growth stands of pine and spruce above 8,000 feet in elevation, with closed canopies, downed vegetation, and available food sources. The primary threat to the subspecies is habitat alteration caused by drought, changes in the fire regime, climate change, and insect-caused epidemics to spruce populations. The subspecies is also threatened by human-caused mortality and competition from the non-native Abert’s squirrel (*Sciurus aberti*). (USFWS, 2011a)

New Mexico Meadow Jumping Mouse. The New Mexico meadow jumping mouse is a subspecies of the meadow jumping mouse (*Zapus hudsonius*) that is endemic to New Mexico, Arizona, and parts of southern Colorado, although it has been extirpated from much of its historic range (USFWS, 2014c). It has grayish-brown fur and a white belly. The species grows up to 10 inches in length including its 5-inch bicolored tail. The species was listed as endangered in 2014, (79 FR 33119 33137, June 10, 2014) and, in Arizona, was designated as having critical habitat along in the White Mountains of Apache County (79 FR 19307 19313, April 8, 2014) (USFWS, 2015l).

The jumping mouse has specific requirements for habitat, nesting in dry soils with riparian vegetation. The jumping mouse is generally nocturnal, but during the summer the jumping mouse may also be seen during the day preparing for hibernation. The jumping mouse hibernates approximately nine months out of the year, longer than most other mammals. Threats to the jumping mouse include specific changes to its habitat such as water shortages or flooding, wildfires, and grazing. (USFWS, 2014c)

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

The ocelot uses a wide range of habitats and ecosystems; however, it is typically limited to microhabitats with dense habitat cover. The ocelot historically had a large range in Texas and Arizona. Presently in Arizona, the species is found in Cochise, Gila, Graham, Maricopa, Pima, Pinal, and Santa Cruz Counties. Because the species has large home ranges, some individuals in in the southern part of the state may also inhabit land in Mexico. 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 United States. (USFWS, 2010b)

Sonoran Pronghorn. The Sonoran pronghorn is a subspecies of American pronghorn (*Antilocapra americana*) endemic to the Sonoran Desert of southwestern Arizona and northwestern Mexico. The pronghorn is a medium-sized ungulate[105] with tan and white fur and distinct pronged horns. The Sonoran subspecies is distinguished from other pronghorn by its unique habitat requirements, smaller size, and paler coloration. (USFWS, 2015n)

The Sonoran pronghorn was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973 with no critical habitat. Experimental populations were reintroduced into southwestern Arizona in 2010 and afforded different protection status (75 FR 5732 5745, February 4, 2010) (USFWS, 2015bd).

The range of the Sonoran pronghorn is limited entirely to lower and upland divisions of the Sonoran Desert, in Arizona and Mexico. While historically widespread in this environment, the subspecies began to decline sharply in the 1800s with the increased use of barbed-wire fencing. By the 1920s, the subspecies' population was estimated to have declined to 100 individuals. As of December 2014, the subspecies' population in Arizona was about 200 individuals in two populations, found in La Paz, Maricopa, Pima, Pinal, Santa Cruz, and Yuma Counties.[106] Within their range, the subspecies are found in open flat terrain, with paloverdes and chain-fruit cholla associations. Current threats to the Sonoran pronghorn are habitat loss, habitat fragmentation, drought, reduced forage quality, genetic bottlenecking, predation, disease, and vehicular mortality. (USFWS, 2015n).

Reptiles

Four threatened reptile species are federally listed for Arizona as summarized in Table 3.1.6-4. The desert tortoise (*Gopherus agassizii*) occurs in northwestern Arizona. The narrow-headed garter snake (*Thamnophis rufipunctatus*) occurs in northeastern Arizona. The New Mexican ridge-nosed rattlesnake (*Crotalus willardi obscurus*) occurs in southeastern Arizona. The Northern Mexican gartersnake (*Thamnophis eques megalops*) occurs throughout Arizona. The Sonoyta mud turtle (*Kinosternon sonoriense longifemorale*) and Sonoran desert tortoise (*Gopherus morafkai*) are identified as candidate species in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

[105] Ungulate: Having hooves (Merriam Webster, Dictionary, 2015c).
[106] Sonoran pronghorn (*Antilocapra americana*) found elsewhere in the state are considered experimental populations (USFWS, 2015n).

Table 3.1.6-4: Federally Listed Reptile Species of Arizona

Common Name	Scientific Name	Federal Status[a]	Critical Habitat in Arizona	Habitat Description
Desert Tortoise	*Gopherus agassizii*	T	Yes	Sandy flats, rocky foothills, or alluvial fans in Mojave Desertscrub plant communities.
Narrow-headed Gartersnake	*Thamnophis rufipunctatus*	T	No	Clear, rocky, permanent streams and rivers, between 4,000 and 6,000 feet in elevation.
New Mexican Ridge-nosed Rattlesnake	*Crotalus willardi obscurus*	T	No	Pine-oak woodlands and pine forests above 5,000 feet elevation in the Sky Island mountain ranges.
Northern Mexican Gartersnake	*Thamnophis eques megalops*	T	No	Ponds, springs, and riparian forests of lowland rivers and upland streams, typically between 3,000 and 5,000 feet in elevation.

Source: (USFWS, 2015e)

[a] T = Threatened

Desert tortoise Photo Credit: USFWS

Desert Tortoise. The desert tortoise is one of two species of *Gopherus* native to the western United States. Until recently, the desert tortoise was believed to be one species composed of two populations: the “Mojave” and “Sonoran.” However, the two populations were found to be genetically distinct and are now recognized as separate species, referred to as the Mojave desert tortoise (or desert tortoise) and the Sonoran desert tortoise. The Mojave desert tortoise ranges north and west of the Colorado River (including Mohave County, AZ) while the Sonoran desert tortoise ranges south and east it (including La Pas and Mohave Counties). (AZGFD, 2015f)

The desert tortoise was federally listed as threatened in 1980 (45 FR 55654 55666, August 20, 1980) and critical habitat designated in 1994 (59 FR 5820 5866, February 8, 1994). Critical habitat for both species of desert tortoise in Arizona is in the northwestern portion of Mohave County (Figure 3.1.6-3) (USFWS, 2015o).

The desert tortoise has a thick domed shell with yellowish centers that have grooved, concentric rings. This species has round, stumpy hind legs and flattened front limbs for digging. The desert tortoise has a small, rounded head, small greenish-yellow eyes, and a short tail. Mature adults typically weigh between 8 to 15 pounds and are approximately 4 to 6 inches in height. It spends the majority of its life underground and it prefers to live in a variety of desert habitats that range from sandy flats to rocky foothills and alluvial fans where suitable soils for digging can be found. In Arizona, the species occurs in areas of Mojave desertscrub. This species depends on bushes and shrubs for shade and protection from predators such as coyotes. Primary threats to this species include habitat loss, degradation, and fragmentation. (USFWS, 2014d)

Narrow-headed Gartersnake. The narrow-headed gartersnake is a species of gartersnake (*Thamnophis*) native to the mountains of central and eastern Arizona, western New Mexico, and northern Mexico. It is a medium-sized, olive colored snake with distinguishing dark spots on the back and sides of its body and a triangular shaped head. It grows to approximately 44 inches in length (AZGFD, 2012b). The species was listed as threatened by the USFWS in 2014 (79 FR 38677 38746, July 8, 2014) with critical habitat proposed in 2013 (78 FR 41549 41608, July 10, 2013) (USFWS, 2015p).

The narrow-headed gartersnake is found in sunlit patches along clear, rocky, permanent streams and rivers. It is typically associated with the riparian portions of pine-forests between 4,000 and 6,000 feet in elevation. Extirpated from many of its historic watersheds, the species is currently most populous in Oak Creek and the East Verde River. Threats to the species include habitat modification, a declining water table, livestock grazing, recreational disturbance, habitat fragmentation, and introduction of invasive predators such as predatory fish, bullfrogs (*Lithobates catesbeianus*), and crayfish (*Orconectes virilis* and *Procambarus clarki*). (AZGFD, 2012b)

New Mexican Ridge-nosed Rattlesnake. The New Mexican ridge-nosed rattlesnake is a subspecies of ridge-nosed rattlesnake (*Crotalus willardi*) that is endemic to three mountain ranges of southwestern New Mexico, southeastern Arizona, and northern Mexico. It is a small rattlesnake, up to 668 mm (26.3 inches). Its coloration is gray or brown and it has a distinct ridge on the end of its nose (AZGFD, 2013c). The New Mexican subspecies was listed as Threatened with critical habitat in the Animas Mountains of New Mexico in 1978 (43 FR 34476 34480, August 4, 2015). It has no critical habitat currently established in Arizona (USFWS, 2015q).

While other subspecies of ridge-nosed rattlesnakes occur in most of the Sky Island mountain ranges of Arizona and New Mexico, the New Mexico Subspecies only occurs in the Animas range of New Mexico, the Peloncillo range of New Mexico and Arizona, and the Sierra de San Luis range of Mexico. Within its range, it is found in pine-oak woodlands and pine forests above 5,000 feet of elevation. The snake is a general feeder, feasting on birds, small mammals, lizards, snakes, and insects (AZGFD, 2013c). The subspecies is assumed to have never been common, but over-collection likely contributed to its decline in population. Current threats include a limited and disjunct range, habitat alteration/destruction, predation, starvation, and disease (AZGFD, 2013c) (USFWS, 1985a).

Northern Mexican Gartersnake. The northern Mexican gartersnake is a subspecies of Mexican gartersnake (*Thamnophis eques*) native to watersheds of Arizona, New Mexico, and northern Mexico. It is an olive-colored snake with a dark stripe down its sides. The northern Mexican gartersnake is only distinguished from other gartersnakes of the southwest by the location of this stripe on its side. It is a medium-sized snake and grows to approximately 44 inches in length (AZGFD, 2012c). The subspecies was listed as threatened by the USFWS in 2014 (79 FR 38677 38746, July 8, 2014) with critical habitat proposed in 2013 (78 FR 41549 41608, July 10, 2013). In Arizona, it is found in 13 counties throughout the state (USFWS, 2015r).

The narrow-headed gartersnake is found ponds, spring fed marshy areas, and the riparian forests of lowland rivers and upland streams, typically between 3,000 and 5,000 feet in elevation. In Arizona, the subspecies has been extirpated from over 90 percent of its historical range, and now is only found in small patches along the Verde River, Tonto Creek, and Ciengas Creek drainages, along with several isolated wetlands. Threats to the species include habitat modification, reduction of prey availability, habitat fragmentation, and introduction of invasive predators such as bullfrogs, and increased competition from non-native species. (AZGFD, 2012c)

Birds

Five endangered and two threatened bird species are federally listed for Arizona as summarized in Table 3.1.6-5. The California condor (*Gymnogyps californianus*) occurs in northern Arizona. The Yuma clapper rail (*Rallus longirostris yumanensis*) occurs in western and central Arizona. The masked bobwhite quail (*Colinus virginianus ridgwayi*) occurs in southern Arizona. The California least tern (*Sterna antillarum browni*), Mexican spotted owl (*Strix occidentalis lucida*), Southwestern willow flycatcher (*Empidonax traillii extimus*), and the Western yellow-billed cuckoo (*Coccyzus americanus*) occur throughout Arizona. The Sprague's Pipit (*Anthus spragueii*) is a candidate species identified in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-5: Federally Listed Bird Species of Arizona

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
California Condor	*Gymnogyps californianus*	E/XN	No	Caves, rock ledges, or tree cavities.
California Least Tern	*Sterna antillarum browni*	E	No	Barren or sparsely vegetated areas, open sandy beaches, sand bars, and shorelines of rivers, lakes, and reservoirs.
Masked Bobwhite Quail	*Colinus virginianus ridgwayi*	E	No	Savannah grasslands with ground cover.
Mexican Spotted Owl	*Strix occidentalis lucida*	T	Yes	Coniferous and hardwood forests with a closed canopy.
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	Yes	Riparian tree and shrub communities near rivers, swamps, and wetlands.
Western Yellow-billed Cuckoo	*Coccyzus americanus*	T	No	Riparian low- to moderate-elevation forests near rivers and streams.
Yuma Clapper Rail	*Rallus longirostris yumanensis*	E	No	Dense cattail or cattail-bulrush marshes.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened, XN = Non-Essential Experimental Population

California Condor. The California condor is a large, soaring, scavenging bird native to western North America. It is one of the largest flying birds in the world, weighing up to 22 pounds with a wingspan of up to 9.5 feet. It is almost entirely black except for white lining under its wings and a bald head (USFWS, 2013c). The species was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and then incorporated into the ESA in 1973. The species was afforded critical habitat in 1975 in the coastal mountains of California (40 FR 58308 58312, January 12, 1975). "In December of 1996, six young captive-bred condors were released …from a site in the Vermilion Cliffs, 30 miles north of Grand Canyon National Park (NPS, 2016a)." The reintroduced condors are members of experimental populations and afforded different protection status, in contrast to other area condor populations, which are classified as Endangered (USFWS, 2015t).

Historically, the California condor inhibited the Pacific coastline and adjacent mountains from British Columbia to Baja California. Prehistoric fossil records indicate the species once ranged across the southern United States, including Arizona. Mortalities from hunting, lead poisoning from the incidental ingestion of bullets, and powerline strikes drastically reduced the species populations through the 19th and 20th centuries. By the late 1980's, the species population was so small that the last remaining condors were brought into captivity for breeding. Populations have been reintroduced to southern and central California, northern Baja California, and northwest Arizona. The species nests in steep, remote, mountainous habitat. Its home range can span 100 miles as it soars over open country foraging for carrion. Current threats to the species include habitat destruction and alteration, predation, lead poisoning, illegal shooting, ingestion of litter, and climate change. (USFWS, 2013c)

California Least Tern. The California least tern is a subspecies of least tern (*Sterna antillarum*) that is native to California and Baja California, with small numbers in Arizona. It is a small seabird with grey coloration above, white undersides, a dark cap, orange/yellow beak, and a distinctive forked tail (USFWS, 2006a). The California subspecies was first listed as endangered under early endangered species legislation in 1970 (35 FR 6069, April 14, 1970) and then incorporated into the ESA in 1973 with no critical habitat (USFWS, 2015e).

The California least tern's breeding range is found from near San Francisco to Baja California (USFWS, 2006a). The species has also been known to breed in Arizona, and two breeding pairs were identified in Maricopa County in 2009. A coastal bird, the breeding pairs in Arizona were found nesting along manmade settling ponds (CDFG, 2009). The species typically nest in colonies of around 25 pairs on open beaches within the tidal zone that are clear of vegetation. Adults forage in the ocean near shore or in lagoons, usually within several miles of their nesting colony. Threats to the subspecies include habitat loss and fragmentation, human disturbance, food shortage, contamination events such as oil spills, and predation (USFWS, 2006a).

Masked Bobwhite. The masked bobwhite is a subspecies of northern bobwhite quail (*Colinus virginianus*) that is native to southern Arizona and northwestern Sonora, Mexico. Males have a reddish orange breast, black face or "mask," and brown, mottled wings while females are mostly mottled with a yellowish face. The masked subspecies is differentiated by other subspecies by its smaller size and the black mask on adult males (USFWS, 1995a). The species was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and then incorporated into the ESA in 1973 with no critical habitat. (USFWS, 2015u).

The masked bobwhite is endemic to the subtropical grasslands and thornscrub savannas of the upland Sonoran Desert. It historically ranged from the Altar Valley in Pima County, Arizona, to the Rio Yaqui in Sonora, Mexico. Within its range, the subspecies prefers to occupy bottoms of seasonal drainages with 15-30 percent shrub cover in grasslands with dense native grasses such as sacaton (*Sporobolus wrightii*). Alteration of grassland habitats for livestock grazing in Arizona and Mexico in the late 1800s caused a sharp decline in the subspecies population. Historically populous, by 1990, it was extirpated from Arizona and rare in Mexico. Reintroduction efforts in Arizona began in the 1980s and have reestablished a population on the Buenos Aires National Wildlife Refuge. The primary threat to this subspecies is its extremely limited population size, making it susceptible to catastrophic events such as wildfire. (USFWS, 1995a)

Mexican Spotted Owl. The Mexican spotted owl is one three subspecies of the spotted owl (*Strix occidentalis*) that is native to the mountainous regions of the southwestern United States. 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 (Figure 3.1.6-3) (69 FR 53182 53298, August 31, 2004). In Arizona, the species has critical habitat in the mountainous portions of Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz, Yavapai counties. (USFWS, 2015v)

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. This species uses a diverse array of habitats for foraging and roosting and some undergo altitudinal migration during winter for nesting. In Arizona, this species is found across the state in areas with suitable mountainous or rocky canyon habitat. The two primary threats for this species include the alteration of habitat due to timber harvesting and stand-replacing wildland fire. (USFWS, 2012b)

Southwestern Willow Flycatcher. The southwestern willow flycatcher is a subspecies of the willow flycatcher (*Empidonax traillii*) that is native to the southwestern United States 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 (Figure 3.1.6-3) (78 FR 343 534, January 3, 2013), approximately 32,000 acres of which was established in Arizona (USFWS, 2015w). The USFWS has initiated a review to delist the Southwestern willow flycatcher (51 FR 14059 14072, March, 16, 2016).

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 historical distribution of the species in Arizona included portions of all watersheds within the state. The species is now limited to the Big Sandy, Bill Williams, Colorado, Gila, Hassayampa, Little Colorado, Salt, San Francisco, San Pedro, Santa Cruz, Santa Maria, and Verde river drainages and the Tonto Creek drainage (USFWS, 2002a). 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, 2002a) (USFWS, 2014e).

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 United States. Widely distributed across the United States, 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 critical habitat has been proposed (79 FR 48547 48652, August 15, 2014) (USFWS, 2015x). Currently, the western yellow-billed cuckoo is known to breed in Arizona, California, Colorado, Idaho, New Mexico, Nevada, and Utah (Johnson, 2009).

Western yellow-billed cuckoos inhabit large, continuous blocks of riparian habitat of cottonwood and willow trees, typically near water. The yellow-billed cuckoo breeds in forested areas with significant canopy cover (Johnson, 2009). The species was once locally common in Arizona, but established populations (greater than 10 breeding pairs) are now limited to the Bill Williams River, Colorado River, Gila River, Hassayampa River, San Pedro River, Santa Maria River, Verde River, Sonoita Creek, Santa Cruz River, Upper Cienega Creek, Altar Valley, and Agua Fria River (USFWS, 2013d). 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, 2015x).

Yuma Clapper Rail. The Yuma clapper rail is a subspecies of the clapper rail (*Rallus longirostris*) that is native to the lower Colorado River watershed in the southwestern United States and northwestern Mexico. It is a small, brown water-bird with dark spots the upper body and a long orange beak. Males average a height of 8 inches and a weight of 270 grams (USFWS, 2010c). The Yuma subspecies was first listed as endangered by the USFWS on the ESA (32 FR 4001, March 11, 1967). No critical habitat has been designated for this species (USFWS, 2015y).

The historic distribution to the Yuma clapper rail is unknown, but it likely was well distributed throughout the lower Colorado River watershed. The subspecies currently has a spotty distribution throughout the watershed. Populations in Arizona exist along the Colorado River from the Mexico border to the Grand Canyon, along the Virgin River, and along the lower Gila River from its confluence with the Colorado River to near Phoenix. The Yuma clapper rail is typically found along the edges of freshwater marshes, dominated by emergent wetland vegetation and overhead riparian vegetation. Ideal marsh vegetation for the subspecies is over six feet in height. Damming of the Colorado River and its tributaries has severely altered the vegetation regime along the riverbanks; this large-scale habitat alteration was likely the greatest cause of the Yuma clapper rail's population decline. Current threats to the species include continued destruction or alteration of habitat, environmental contaminants, habitat fragmentation, and climate change. (USFWS, 2010c)

Fish

There are 13 endangered and 6 threatened fish species federally listed in Arizona as summarized in Table 3.1.6-6. The humpback chub (*Gila cypha*), Virgin River chub (*Gila seminude*), and the woundfin (*Plagopterus argentissimus*) occur in northwestern Arizona. The Apache trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), and the Zuni bluehead sucker (*Catostomus discobolus yarrow*) occur in northeastern Arizona. The bonytail chub (*Gila elegans*) occurs in western Arizona. The loach minnow (*Tiaroga cobitis*) occurs in eastern Arizona. The spikedace (*Meda fulgida*) is found in east-central Arizona. The Sonora chub (*Gila ditaenia*) occurs in southern Arizona. The beautiful shiner (*Cyprinella formosa*), Gila topminnow (*Poeciliopsis occidentalis*), Yaqui catfish (*Ictalurus pricei*), and the Yaqui chub (*Gila purpurea*) occur in southeastern Arizona. The pikeminnow squawfish (*Ptychocheilus lucius*) occurs in central Arizona. The desert pupfish (*Cyprinodon macularius*), Gila chub (*Gila intermedia*) and Gila trout (*Oncorhynchus gilae*) occur in southeastern and central Arizona. The razorback sucker (*Xyrauchen texanus*) occurs throughout Arizona. The roundtail chub (*Gila robusta*) and the headwater chub (*Gila nigra*) have been identified as candidate species in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-6: Federally Listed Fish Species of Arizona

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Apache Trout	*Oncorhynchus apache*	T	No	Cool, clear, waterbodies with rocky substrates in pine forests above 6,000 feet in elevation.
Beautiful Shiner	*Cyprinella formosa*	T	Yes; all aquatic habitats of San Bernardino NWR	Riffles and intermittent pools of small streams or rivers.
Bonytail Chub	*Gila elegans*	E	Yes; in the Colorado River and Lake Mohave in Mohave and La Paz counties, Arizona	River channels, and flooded, ponded, or inundated river eddies and pools.
Colorado Pikeminnow	*Ptychocheilus lucius*	E/XN	No	Pools, deep runs, and eddies maintained by high spring flows.
Desert Pupfish	*Cyprinodon macularius*	E	Yes; in Quitobaquito Springs, Pima County, Arizona	Springs, marshes, streams, and shallow portions of rivers and lakes, all within arid desert settings.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Gila Topminnow	*Poeciliopsis occidentalis*	E	No	Shallow, warm, slow moving, quiet waters.
Gila Chub	*Gila intermedia*	E	Yes; in Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties, Arizona	Diverse range of aquatic habitats within smaller headwater streams, springs, or marshes, between 2,700 to 5,400 feet in elevation.
Gila Trout	*Oncorhynchus gilae*	T	No	Cool, clear, waterbodies with rocky substrates in pine or mixed-conifer forests above 5,400 feet in elevation.
Humpback Chub	*Gila cypha*	E	Yes; within Little Colorado and Colorado Rivers in the Grand Canyon region of Mohave and Coconino counties, Arizona	Prefers fast currents and deep pools with boulders.
Little Colorado Spinedace	*Lepidomeda vittata*	T	Yes; East Clear Creek, Coconino County; Chevelon Creek, Navajo County; and Nutrioso Creek, Apache County; northeastern Arizona	Permanently flowing sections of small streams with clear to murky water and sandy, gravelly, or rocky substrates.
Loach Minnow	*Tiaroga cobitis*	E	Yes; in Apache, Coconino, Gila, Greenlee, Graham, Pinal, and Yavapai counties, Arizona	Along the bottoms of swift-moving mainstream rivers or tributaries, usually with rocky substrates, between approximately 2,300 to 8,200 feet in elevation.
Razorback Sucker	*Xyrauchen texanus*	E	Yes; in the Gila, Salt, Verde, and Colorado Rivers of Arizona	Deep runs, eddies, backwaters, and flooded environments in spring; runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter. Spawning in rivers occurs over bars of cobble, gravel, and sand substrates during spring runoff at widely ranging flows and water temperatures.
Sonora Chub	*Gila ditaenia*	T	Yes; in Sycamore and Peñasco creeks in Santa Cruz county, Arizona	Large, deep, permanent pools with bedrock or sandy substrates.
Spikedace	*Meda fulgida*	E	Yes; in Apache, Cochise, Gila, Graham, Greenlee, Pinal, and Yavapai counties, Arizona	Moderate to large perennial streams, in shallow riffles and runs over sand, gravel, and cobble substrates with flowing current.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Virgin River Chub	*Gila seminuda*	E	Yes; in the Virgin River mainstem and associated floodplain in Mohave County, Arizona	Deep protected water and relatively fast currents.
Woundfin	*Plagopterus argentissimus*	E/XN	Yes; in and along the Virgin River, which passes through Mohave County, Arizona	Occurs in warm, quiet water habitats with sand substrates within the mainstem of the Virgin River.
Yaqui Catfish	*Ictalurus pricei*	T	Yes; aquatic habitats of the Rio Yaqui drainage in the San Bernardino NWR	Ponds or streams, usually in larger rivers, but also in small sections of streams in quiet, clear pools. Most often found in large rivers over sand or rock substrates in medium to slow current.
Yaqui Chub	*Gila purpurea*	E	Yes; aquatic habitats of the Rio Yaqui drainage in the San Bernardino NWR	Deep pools with dense aquatic vegetation near undercut banks or debris in small streams, as well as areas with clean, gravel substrates with lots of algae growth in faster currents.
Zuni Bluehead Sucker	*Catostomus discobolus yarrowi*	E	No	Streams with clean, perennial water over hard substrate like bedrock or boulders covered in algae.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened, XN = Non-Essential Experimental Population

Apache Trout. The Apache trout, the state fish of Arizona, is a species of trout (*Oncorhynchus*) endemic to high elevation reaches of the White Mountains, in Gila, Apache, and Greenlee Counties, Arizona. The species is a medium-sized fish, rarely exceeding two feet in length, is yellow or olive in color and contains dark spots across its body (USFWS, 2009b). It was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973. In 1975, the species was reclassified as threatened (40 FR 17847 17848, July 16, 1975). There is currently no critical habitat for the species (USFWS, 2015s) (USFWS 2015x).

"Historically, Apache trout occupied streams and rivers in the upper White, Black, and Little Colorado River drainages in the White Mountains of east-central Arizona. [As of 2009], 28 pure Apache trout populations exist[ed] within the historical range in Gila, Apache, and Greenlee Counties of Arizona, [and] on lands of the Fort Apache Indian Reservation and Apache-Sitgreaves National Forest" (74 FR 45649 45650, September 3, 2009). Preferred habitats are cool, cool, clear, waterbodies with rocky substrates in pine forests above 6,000 feet in elevation. The species often finds cover under shady overhangs or downed vegetation. It feeds on small invertebrates, either live or drifting. Suitability of habitat for the species is reliant on healthy riparian vegetation; therefore, the species' success is impacted by local land management practices. Threats to the species include habitat loss, over-grazing, damming of waterways, bank destabilization from destruction of riparian vegetation, and competition or hybridization with non-native trout (USFWS, 2009b).

Beautiful Shiner. The beautiful shiner is a species of shiner (*Cyprinella*) endemic to the Rio Yaqui and Guzman Basin watersheds in northwestern Mexico, and parts of Arizona and New Mexico. It is a small blue fish with bronze-orange coloration its head and fins. The species grows up to 3.5 inches and has a distinctive compressed body (AZGFD, 2001b). The species was federally listed as threatened in 1985 (49 FR 34490 34497, August 31, 1984) with critical habitat designated in Rio Yaqui drainage in the San Bernardino NWR (Figure 3.1.6-3) (USFWS, 2015z).

The beautiful shiner was historically found throughout the Rio Yaqui and Guzman Basin watersheds, including in San Bernardino Creek in Cochise County, Arizona. While still found in most of its historic range in Mexico, the species was extirpated from Arizona in the early 1970's. Reintroduction efforts began in 1990 in freshwater ponds on the San Bernardino National Wildlife Refuge, which have been successful. Within its range, the species inhabits riffles and intermittent pools of small streams or rivers. It is omnivorous, feeding mostly on drifting insects or plant material. It spends the majority of its time in the mid-water column, near but not within beds of plants along pond margins. Current threats to the species include drought, groundwater pumping, reduction in stream flow, and competition or predation from nonnative species. (AZGFD, 2001b) (USFWS, 1995b)

Bonytail Chub. The bonytail chub is an extremely rare, long-lived fish, once prevalent in the Colorado River basin. The species has a streamlined body, concave skull, and thin pencil-like appearance; "adults attain a maximum size of about 550 mm total length [1.8 feet] and 1.1 kg [2.4 lbs] in weight" (USFWS, 2002b). The species was federally listed as endangered in 1980, (45 FR 27710 27713, April 23, 1980). In Arizona, critical habitat for the bonytail chub is designated in seven reaches of the Colorado River system (the Colorado, Green, and Yainpa Rivers in La Paz, Mohave, and Yuma Counties), which is about 14 percent the species' historical habitat (Figure 3.1.6-3) (59 FR 13374 13400, March 21, 1994) (USFWS, 2015aa).

The bonytail chub is the rarest native fish in the Colorado River Basin and has been observed infrequently in the last decades. Historically, the fish's range was widespread and abundant throughout the Colorado River Basin in the warmer waters from Mexico to Wyoming. Today, few populations are known to exist in the upper Colorado and Green Rivers and Lake Mohave (USFWS, 2002b).

Though little is known about this rare fish, drawing upon other similar chub, it is speculated that spawning occurs in eddies during the months of June and July and that habitats required for conservation include, river channels, and flooded, ponded, or inundated river eddies and pools.[107] Threats to the species include impacts to river hydrology, which modify water temperatures, flow rates, and sedimentation of the species habitat. Since 1905, in the lower Colorado River

[107] Adult bonytail chub have been observed in pools and eddies (USFWS, 2002b).

Basin there have been more than 14 dams, which impede migration, and make the variability of the genepool less diverse, and have introduced non-native competition from other species. Additional threats include pesticides and pollutants, disease and predation (USFWS, 2002b).

Colorado Pikeminnow (=squawfish). The Colorado pikeminnow, or also known as the Colorado squawfish, is the largest American minnow reaching up to six feet in length and weighing more than 80 pounds. The speckled greenish fish has an elongated body, long slender head, teeth in its throat and gills rather than jaws (USFWS, 2014h). The pikeminnow was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C §1531 *et seq*.). In 1994, the species was designated with critical habitat (59 FR 13374 13400, March 21, 1994) in Colorado, New Mexico, and Utah. Additionally, experimental populations have been released into the Salt and Verde River drainages in central Arizona, which are afforded different protections under the ESA (USFWS, 2015as).

Historically, the species was endemic throughout the Colorado River Basin, though today, populations occur only in portions of the Green River, upper Colorado River, and San Juan River, with experimental populations in the Salt and Verde rivers. The Colorado pikeminnow migrate long distances; swimming hundreds of miles to and from spawning areas. Species habitat requirements include pools, deep runs, and eddies maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats. After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters. Threats to the species include streamflow regulation, habitat modification, competition with and predation by non-native fish species, and pesticides and pollutants (USFWS, 2002c).

Desert Pupfish. The desert pupfish is a small, silver- or blue- colored fish native to the southwestern United States and northwestern Mexico. Adults grow to approximately two inches in length. Males have an iridescent blue coloration with yellow tails, while females and juveniles are silver in color. Both males and females have dark vertical stripes on their sides. The species was federally listed as endangered in 1986 (51 FR 10842 10851, March 31, 1986) with critical habitat established in Quitobaquito Spring, Pima County, Arizona and San Felipe Creek, Carrizo Wash, and Fish Creek Wash, Imperial County, California. (USFWS, 2015ac)

The desert pupfish was historically abundant in the waterways of southern Arizona, southeastern California, and northwestern Mexico. Natural populations of the species within the United States are now limited to Quitobaquito Springs in Arizona and several small tributaries of the Salton Sea in California. As many as 1,000 individual pupfish are also living in transported populations in various locations across Arizona. The species' natural habitat is varied and includes springs, marshes, streams, and shallow portions of rivers and lakes, all within arid desert settings. The desert pupfish is a hardy species and can withstand habitats with high temperatures, high levels of salinity, and low dissolved oxygen. Primary threats to the species include habitat loss, habitat alteration, pollution, and competition or predation from non-native species. (USFWS, 1993a)

Gila Topminnow. The Gila topminnow is the northernmost ranging species of the tropical *Poeciliopsis* genus, and native to the southwestern United States and northwestern Mexico. It has two subspecies, *P.o. occidentalis* in the Gila River watershed and *P.o. sonoriensis* in the Rio Yaqui watershed. It is a small silver fish with dark spots across its body that grows to approximately two inches in length. The species, including both subspecies, was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973 with no designated critical habitat. (USFWS, 2015ae)

Historically, the Gila topminnow was widespread in the Gila River and its tributaries in Arizona, at reaches below 5,000 feet in elevation. Their numbers have since been reduced to only 14 naturally occurring populations in Arizona. Reported to be the most reintroduced fish species in the U.S. Southwest.[108] The species prefers shallow, warm, slow moving, quiet waters, although it can tolerate a variety of habitats. It is well adapted to its seasonally variable environment as it can burrow into mud and withstand several days out of water. Historically, the species likely would quickly repopulate seasonal waterways quickly after rain events. The primary threat to the species is habitat alteration, as the Gila River watershed has undergone intensive reclamation projects and no longer flows naturally. The species is also threatened by competition or predation from non-native species such as mosquitofish (*Gambusia affinis*). (USFWS, 1998)

Gila Chub. The Gila chub is a small minnow native to the Gila River watershed in the southwestern United States and northwestern Mexico. It is a dark olive-gray colored fish with a light belly. Males and females grow to different sizes, with males rarely reaching 6 inches in length and females growing up to 8 inches in length. The species was federally listed as endangered in 2005 (70 FR 66664 66721, November 2, 2005) with critical habitat designated in Yavapai, Gila, Greenlee, Graham, Cochise, Santa Cruz, Pima, and Pinal Counties (Figure 3.1.6-3). (AZGFD, 2002) (USFWS, 2015ag)

The Gila chub historically occupied many of the headwaters of the Gila River in Arizona, New Mexico, and Sonora, Mexico. The species is now extirpated from New Mexico and its range is restricted in Arizona and Sonora, Mexico. The species typically is found in a diverse range of aquatic habitats within smaller headwater streams, springs, or marshes, between 2,700 and 5,400 feet in elevation. Its population size is naturally dynamic, expanding, and contracting with seasonal habitat availability. Threats to the species include habitat destruction, habitat alteration from livestock or reclamation projects, and competition or predation from non-native species such as crayfish. (AZGFD, 2002)

Gila Trout. The Gila trout is a species of trout endemic[109] to cool streams of the Gila, San Francisco, Agua Fria, and Verde River watersheds in east and central Arizona and western New Mexico. The species is similar in size and appearance to the closely related Apache trout, although their range has very little overlap. It is distinguishable by its iridescent gold color (USFWS, 2003). The species was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973.

[108] As of 1998, the Gila topminnow had been reintroduced 360 times in waterways Arizona and New Mexico (USFWS, 1998).
[109] Endemic: a species is endemic when it is a native species confined to a particular region. Endemic species are not found outside of their range. (USFWS, 2015bm)

In 1987, the species was reclassified as threatened (52 FR 37424 37427, October 6, 1987). There is currently no critical habitat for this species (USFWS, 2015ai).

Within Arizona, the Gila trout inhabit mountain streams in various sub-basins of the Gila River watershed in Apache, Coconino, Gila, Graham, Greenlee, Navajo, and Yavapai Counties. It is found in cool, clear, waterbodies with rocky substrates in pine or mixed-conifer forests above 5,400 feet in elevation. Similarly to the Apache trout, the Gila trout is reliant on healthy riparian vegetation and, therefore, is impacted by local land management practices. Threats to the species include habitat destruction and alteration, severe fires, illegal fishing, disease, and competition or hybridization with non-native trout species. (USFWS, 2003)

Headwater Chub. The headwater chub is an endemic species of the Gila River basin of Arizona and New Mexico. It is a medium-sized fish, growing up to 20 inches long, with an olive-silver body that fades to a whitish underbelly. The headwater chub is similar in appearance to the humpback and roundtail chub, but is differentiated by larger eyes and a more trout-like appearance (AZGFD, 2015g). The species is currently being proposed for federal listing as threatened (80 FR 60753 60783, October 7, 2015) with no critical habitat (USFWS, 2015ak).

The current range for the headwater chub within Arizona is within Ash Creek, Tonto Creek, and Spring Creek, Marsh Creek, Upper Fossil Creek, East Verde River and Deadman Creek. The species is typically found in cool to warm, deep pools near riffles and flow obstructions, within mid-sized headwater streams, between 4,200 and 5,000 feet in elevation. The species is omnivorous and feeds on aquatic or terrestrial insects, macroinvertebrates, and plant material. Current threats to the species include habitat loss, a declining water table, drought, and increased competition or predation from non-native species. (AZGFD, 2015g)

Humpback Chub. The humpback chub is a long living fish growing up to 15 inches with a pronounced hump from above the gills to its dorsal fin. The species is grey or olive colored on its back with silver sides, a white belly, and rosy fins during mating season (USFWS, 2014g). The humpback chub was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was later incorporated into the ESA as an endangered species (16 U.S.C §1531 *et seq*.). The species was designated with critical habitat in 1994 (Figure 3.1.6-3) (59 FR 13374 13400, March 21, 1994), within the Colorado and Little Colorado rivers in the Grand Canyon region of Mohave and Coconino counties, Arizona (USFWS, 2015an).

Historically, the humpback chub was endemic to the Colorado River basin, though today populations are restricted to the Colorado, Little Colorado, Green, and Yampa Rivers. The largest known population of humpback chub, and the only population in Arizona, is in the Lower Colorado River, at the confluence with the main stem of the Little Colorado River (USFWS, 2016c). Factors such as stream alteration (dams, irrigation, dewatering, and channelization); competition with and predation by non-native fish species; hybridization with other *Gila* species may have led to the decline of the humpback chub (USFWS, 1990a).

Little Colorado Spinedace. The Little Colorado spinedace is a species of minnow endemic to tributaries of the Little Colorado River in Apache, Coconino, Gila, and Navajo counties, Arizona. It is a small, silver-colored fish that averages four inches in length. Breeding males develop intense reddish-orange coloration on the bases of their paired fins. The species was first listed as endangered under early endangered species legislation in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA in 1973. In 1987, the species was reclassified as threatened (52 FR 35034 35041, September 16, 1987) with critical habitat designated in Arizona (Figure 3.1.6-3). (USFWS, 1997a) (USFWS, 2015h)

The Little Colorado spinedace were historically found in a much larger stretch of the Little Colorado River watershed, including into the Zuni River of New Mexico. Currently, the species is limited to the Little Colorado's north flowing tributaries, all within Arizona. Within their range, the species will typically occupy permanently flowing sections of small streams with clear to murky water and sandy, gravelly, or rocky substrates. The species is predatory, feeding on aquatic insects and larvae, although it will eat algae and plant material as well. The Little Colorado spinedace populations naturally fluctuate dramatically from year to year, making it difficult to quantify its decline. However, the species is believed to be declining because of a decrease in water discharge, flow alterations, and changes in sedimentation, all due to the damming of the Little Colorado River and its tributaries. Current threats to the species include a limited range, chemical contamination of habitat, increased sedimentation, and increased competition or predation from non-native species. (USFWS, 1997a)

Loach Minnow. The loach minnow is a small, olive-colored minnow with an elongated body that is endemic to the Gila River watershed of Arizona, New Mexico, and Sonora, Mexico. The species is distinguished by other dace species by whitish spots present on its dorsal fins (AZGFD, 2010). The loach minnow was federally listed as a threatened species in 1986 (51 FR 39468 39478, October 28, 1986) and was afforded critical habitat in 1994 (59 FR 10896 10898, March 8, 1994). In 2012, the species was relisted as endangered with new designated critical habitat (Figure 3.1.6-3) (77 FR 10810 10932, February 23, 2012). Within Arizona, the species currently has critical habitat established in Apache, Coconino, Gila, Greenlee, Graham, Pinal, and Yavapai counties (USFWS, 2015aq).

The loach minnow historically ranged widely across the Gila River watershed, but are now limited to approximately 10 percent of their historic range. In Arizona, the species has been extirpated from all but portions of the Black River, White River, north and east forks of the White River, Aravaipa Creek, San Francisco River, Blue River, and Campbell Blue Creek, and Eagle Creek. Within its range, it is found along the bottoms of swift-moving mainstream rivers or tributaries, usually with rocky substrates, between approximately 2,300 and 8,200 feet in elevation. Greatest threats to this species in Arizona are stream dewatering, river impoundment, livestock grazing, habitat alteration, and introduced non-native fish. (AZGFD, 2010)

Razorback Sucker. The razorback sucker is a long, slender fish growing up to 39 inches in length and weighing up to 12 pounds. The species is marked with dark head and dorsal fins with a yellowish white underbelly and fins (USFWS, 2014h). The razorback sucker was federally listed as endangered in 1991 (56 FR 54957 54967, October 23, 1991) and was given designated critical habitat in 1994 (Figure 3.1.6-3) (59 FR 13374 13400, March 21, 1994) in the, Gila, Salt, Verde, and Colorado Rivers of Arizona (USFWS, 2015au).

Historically, the razorback sucker was widely distributed in warm-water reaches of larger rivers of the Colorado River Basin from New Mexico to Wyoming. Habitats include features such as eddies in spring, pools found in shallow water near submerged sandbars, and slow running pools and eddies in winter. This species spawns in rivers over cobble, gravel, and sandy substrates in the spring. Threats to the species include changes in streamflow, habitat, and introduction of competitive or predatory non-native fish species, and pesticides and pollutants (USFWS, 2014h) (USFWS, 2002e).

Roundtail Chub. The roundtail chub is a medium-sized, olive/silver chub that is native to the larger tributaries of the Colorado River, along with the Rio Yaqui and Rio Piaxtla in western Mexico. It grows up to approximately 19 inches in length and is distinguishable from other chub species by its larger eyes and lack of a hump on larger individuals (AZGFD, 2015h)(AZGFD 2015c). The lower Colorado River Basin DPS of this species is currently being proposed for federal listing as threatened (80 FR 60753 60783, October 7, 2015) with no critical habitat yet determined (USFWS, 2015bl) (USFWS 2015aj).

Within Arizona, this species is found in several subbasins of the Colorado River watershed: the Little Colorado, Bill Williams, Salt, Verde, Aravaipa Creek (tributary of San Pedro River) and Eagle Creek (tributary of Gila River). Its range has been limited since historic times and the species is now extirpated from its range in New Mexico. The roundtail chub prefers the deep pools of warm to cool rivers and streams, with sufficient cover from vegetation or banks, between 2,000 and 5,000 feet in elevation. The fish is primarily carnivorous and feeds primarily on insects, aquatic invertebrates, and crustaceans. Threats to this species include a decreasing water table, river impoundments, habitat loss, and increased competition or predation from non-native species. (AZGFD, 2015h) (AZGFD 2015c)

Sonora Chub. The Sonora chub is a species of minnow endemic to the Rio de la Conception watershed in Arizona and Sonora, Mexico. It is a small fish, growing to a maximum length of seven inches. It is dark colored with prominent lateral stripes and, on breeding males, bright orange accents on its fins and mouth. The species was federally listed as threatened in 1986 (51 FR 16042 16047, April 30, 1986) with critical habitat established in Sycamore and Peñasco creeks in Santa Cruz county, Arizona (Figure 3.1.6-3). (USFWS, 2015aw)

Within Arizona, the range of the Sonora chub has not changed significantly since historic times. This is because the watershed for which the species inhabits is very limited within the state; it is only known to occur within a small portion of Sycamore Creek in southern Arizona where they are abundant. Within their range, the species is typically found in large, deep, permanent pools with bedrock or sandy substrates. Juveniles will disperse in shallower stretches during increased flow events. The species is highly adapted to a harsh desert watershed with highly variable water flows. The primary threat to this species is its limited range. As such, a catastrophic event such as a flood or fire could easily extirpate the species from the United States. Other threats include habitat alteration and predation from non-native species. (AZGFD, 1996)

Spikedace. The spikedace (*Meda fulgida*) is a small member of the minnow family, reaching less than 3 inches in length. The body is sleek and slender, with scales embedded deep in the skin. It has two spines on the top fin, and large eyes and mouth. The sides of the body are a bright silvery color with black specks, the back is olive-gray to brownish colored that is mottled with darker color, and the underside is white colored. During breeding season, males become brightly golden or brassy in color, especially on the head and bases of the fins (USFWS, 1991). The spikedace was federally listed as endangered in 1986 (51 FR 23769 23781, July 1, 1986), with critical habitat designated in 2012 (77 FR 10810 10932, February 23, 2012) in Apache, Cochise, Gila, Graham, Greenlee, Pinal, and Yavapai counties, Arizona (Figure 3.1.6-3) (USFWS, 2012c) (USFWS, 2015ay).

Its historic range was throughout the Gila River Basin; however, the spikedace has been extirpated from most of this area. It is now found in the upper Gila River in New Mexico, and in the Aravaipa and Eagle creeks, and the upper Verde River in Arizona. It inhabits moderate to large perennial streams, in shallow riffles and runs over sand, gravel, and cobble substrates with flowing current. The main threats to the spikedace are habitat destruction and competition due to dams, water alteration, watershed decline, groundwater pumping, channelization, and the introduction of nonnative fish. (USFWS, 1991) (USFWS, 2012c)

Virgin River Chub. The Virgin River chub *(Gila seminuda (=robusta))* is an extremely rare fish found exclusively in the Virgin River. The species is a minnow with a silvery coloring. The species grows between 8 and 18 inches and length with an average lifespan of 8 to 10 years. The Virgin River chub was federally listed as endangered in 1989 (54 FR 35305 35311, August 24, 1989). The Virgin River chub was first identified as an intermediate species between the roundtail chub (*G. robusta*) and the bonytail chub (*G. elegans*). The species was later determined to be a subspecies of (*G. robusta*); however, further study led to the recognition of the fish as a separate species named *G. seminuda*. (USFWS, 2008a)

Critical habitat within Arizona is designated in the Virgin River mainstem and the associated 100-year floodplain in Mohave County (Figure 3.1.6-3) (65 FR 4140 4156, January 26, 2000). Historically, the species was abundant in the Virgin River into southern Nevada, southwest Utah, and northwest Arizona. Currently, the extent of the species range is similar; however, it has become extremely rare (USFWS, 2014i).

The Virgin River chub prefers deep protected water and relatively fast currents. The species is tolerant of turbidity, salinity, and temperatures below 86 ºF. Spawning occurs from late spring through early summer and eggs are deposited on rocky substrate with no further care. The species is an opportunistic feeder consuming algae, debris, and invertebrates. Threats to the Virgin River chub come from floods, toxic spills, the diversion of water, disease (including Asian fish tapeworm [*Bothriocephalus acheilognathi*]), and competition from non-native fish (particularly red shiner [*Cyprinella lutrensis*]). (USFWS, 2014i)

Woundfin. The woundfin is a small, silvery minnow that grows to up to three inches in length. This species primarily feeds on algae, seeds, detritus and various aquatic insects and larvae (USFWS, 2014j). This species was federally listed as endangered in 1970 (35 FR 16047 16048, October 13, 1970) and was afforded critical habitat in 2000 (Figure 3.1.6-3) (65 FR 4140 4156, January 26, 2000). Similar to the Virgin River chub, critical habitat for this species has been established in and along the Virgin River, which passes through Arizona in Mohave County (USFWS, 2000).

Preferred habitat of the woundfin are main channels of swift, turbid, warm streams over sand substrate (USFWS, 2014f). Historically, this fish species occurred in the Gila, Salt, and Colorado rivers of Arizona and the Moapa River of Nevada, however, this species is now restricted to the Virgin River. The primary threats for this species are low flows and high temperatures. (USFWS, 2014j)

Yaqui Catfish. The Yaqui catfish is a freshwater catfish (*Ictalurus*) that is endemic to the Rio Yaqui watershed of southeastern Arizona and northwestern Mexico. It is similar in appearance to the common channel catfish (*I. punctatus*), but is darker and has shorter pectoral and dorsal spines (AZGFD, 2001c). The species was federally listed as threatened in 1984 (49 FR 34490 34497, August 31, 1984) with critical habitat in Cochise County (Figure 3.1.6-3) (USFWS, 2015bc).

The Yaqui catfish's range in Arizona has always been very limited. Historical records show the species as occurring in San Bernardino Creek and an introduced population in Monkey Creek reservoir. The species was entirely extirpated from the United States by 1973 due to dewatering and livestock impacts. In 1997, a small population was reintroduced into the San Bernardino NWR, which has persisted. Within their range, the species occupies calm, clear pools of larger waterbodies such as rivers or ponds. Because it occupies intermittent waterways, the catfish will find refuge in perennial spring-fed pools during droughts. It is an opportunistic bottom feeder, with a diet consisting of fish, insects, crustaceans, and plant material. Threats to the species include dewatering, habitat alteration, drought, hybridization with other catfish species, and predation or competition from non-native species. (AZGFD, 2001c)

Yaqui Chub. The Yaqui minnow is a medium-sized minnow that is endemic to the Rio Yaqui watershed of southeastern Arizona and northwestern Mexico. The dark colored fish reaches a maximum length of seven inches (AZGFD, 2001d). The species was federally listed as threatened in 1984 (49 FR 34490 34497, August 31, 1984) with critical habitat in Cochise County, Arizona (Figure 3.1.6-3) (USFWS, 2015be).

The Yaqui chub was historically well distributed in the Rio Yaqui watershed within Arizona; however by the mid-1900s, the species had been extirpated from the United States in all of its range except one artesian well in the San Bernardino Creek watershed. Another refuge population has since been established in Leslie Creek. It prefers shaded portions of deep pools, often with dense marshy vegetation, although historically the species would also use swifter portions of large rivers. It feeds on small fish, insects, and plant material. Threats to the species include dewatering, habitat alteration, and predation from non-native species. (AZGFD, 2001d)

Zuni Bluehead Sucker. The Zuni bluehead sucker is a torpedo-shaped, slender fish growing up to 9 inches in length. Its mouth is on the underside of its snout, and this fish has a bluish colored head, silvery-tan to dark green colored back, and yellowish to silvery-white colored sides and abdomen. The adults are colored mottled slate-gray to almost black on the front half of the body, and cream-white on the back half. During spawning, the males have coarse wart like bumps on the back fins and near the tail fin, as well as becoming black colored with a red horizontal band and a white abdomen (USFWS, 2014k). The Zuni bluehead sucker was federally listed as endangered in 2014 (79 FR 43131 43161, July 24, 2014). Critical habitat has been proposed but not designated (USFWS, 2015bg).

Regionally, this species is found in Arizona and New Mexico. In Arizona, it can be found in the Kinlichee Creek watershed in Apache County, in the northeastern part of the state (USFWS, 2014k) (USFWS, 2015bg). It inhabits streams with clean, perennial water over hard substrate like bedrock or boulders covered in algae. Threats to the Zuni bluehead sucker include water withdrawal, sedimentation, impoundments, development, wildfires, livestock grazing, drought, and climate change (USFWS, 2014k).

Amphibians

There are one endangered and one threatened amphibian species federally listed in Arizona as summarized in Table 3.1.6-7. The Sonora Tiger Salamander (*Ambystoma tigrinum stebbinsi*) occur in southeastern Arizona. The Chiricahua Leopard Frog (*Rana chiricahuensis*) occurs in central, east-central, and southeastern Arizona. The Arizona Huachuca/Canelo Treefrog (*Hyla wrightorum*) and the Relict Leopard Frog (*Lithobates onca*) are candidate species in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-7: Federally Listed Amphibian Species of Arizona

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Chiricahua Leopard Frog	*Rana chiricahuensis*	T	Yes; in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties, Arizona.	Stock tanks and other manmade waters, as well as headwater streams and springs that do not have introduced predators.
Sonora Tiger Salamander	*Ambystoma tigrinum stebbinsi*	E	No	Standing water for breeding and growth of larvae; adults inhabit nearby grassland and oak woodland terrestrial areas when not in ponds.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened

Chiricahua Leopard Frog. The Chiricahua leopard frog is a medium sized leopard frog that reaches about 5.4 inches. It is green or brown colored with many small dark spots. It is distinguished from other leopard frogs by its salt and pepper pattern on the rear of the thigh, folds on the back and sides, stocky body proportions, high and upturned eyes, and rough skin on the back and sides. It also has a distinctive call that sounds like a snore, lasting 1 to 2 seconds. The Chiricahua leopard frog was federally listed as threatened in 2002 (67 FR 40790 40811, June 13, 2002) (USFWS, 2014l) (USFWS, 2015bi).

Critical habitat was designated in 2012 (77 FR 16324 16424, March 20, 2012) in Apache, Cochise, Gila, Graham, Greenlee, Pima, Santa Cruz, and Yavapai counties, Arizona (Figure 3.1.6-3) (USFWS, 2012d).

Regionally, this species can be found in Arizona, New Mexico, and Mexico. In Arizona, it is found in 11 counties in the mountains of the central and east-central parts, as well as the mountains and high valleys of the southeastern part of the state (USFWS, 2014l) (USFWS, 2015bi). Historically, it inhabited a variety of wetland habitats, but is now restricted to stock tanks and other manmade waters, as well as headwater streams and springs that do not have introduced predators. Threats to the Chiricahua leopard frog include predation by introduced predators, the introduced fungal skin disease chytridiomycosis, and habitat loss and degradation due to water diversions, groundwater pumping, poor livestock management, wild fire, mining, development, and environmental contamination (USFWS, 2014l).

Sonora Tiger Salamander. The Sonora tiger salamander is a large, stocky salamander that grows from 3 to 6.5 inches long. It has small eyes, a wide rounded nose, and tubercles on the underside of its front and back feet. It has yellow to dark olive colored spots and blotches. Aquatic larvae for the Sonora tiger salamander are dark colored with tail fins and plume-like gills. The Sonora tiger salamander was federally listed as endangered in 1997 (62 FR 665 689, January 6, 1997). (USFWS, 2015bk)

Regionally, this species can be found in Arizona and Mexico. In Arizona, it is found in Cochise and Santa Cruz counties, in the southeastern corner of the state (USFWS, 2015bk). It needs standing water for breeding and growth of larvae; adults inhabit nearby grassland and oak woodland terrestrial areas when not in ponds. Threats to the Sonora tiger salamander include restricted distribution, reduction of natural standing water habitat, predation by nonnative predators, hybridization with nonnative tiger salamanders, disease, and collection (USFWS, 2002d).

Invertebrates

There are two endangered and one threatened invertebrate species federally listed in Arizona as summarized in Table 3.1.6-8. The Kanab Ambersnail (*Oxyloma haydeni kanabensis*) occurs in northern Arizona. The Three Forks Springsnail (*Pyrgulopsis trivialis*) occurs in eastern Arizona. The San Bernardino Springsnail (*Pyrgulopsis bernardina*) occur in southeastern Arizona. The Page Springsnail (*Pyrgulopsis morrisoni*), Stephan's Riffle Beetle (*Heterelmis stephani*), and Huachuca Springsnail (*Pyrgulopsis thompsoni*) are candidate species in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-8: Federally Listed Invertebrate Species of Arizona

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Kanab Ambersnail	*Oxyloma haydeni kanabensis*	E	No	Marshes and other wetland areas that are watered by springs and seeps.
San Bernardino Springsnail	*Pyrgulopsis bernardina*	T	Yes; 2 acres of Cochise County, Arizona.	Springs, seeps, spring runs, and a variety of waters, but is usually found in spring systems that produce running water.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Three Forks Springsnail	*Pyrgulopsis trivialis*	E	Yes; 17.2 acres of Apache County, Arizona.	Spring systems that produce running water at an elevation of approximately 8,000 feet; also found in springs, seeps, spring runs, and a variety of waters over substrates of cobble, gravel, woody debris, and aquatic vegetation, which are necessary for laying eggs and feeding.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened

Kanab Ambersnail. The Kanab Ambersnail is a member of the crustacean and mollusk family. This species is a terrestrial snail that has an amber colored shell and is approximately 0.5 inches in length. The Kanab Ambersnail was listed as an endangered species in 1991 due to existing and potential habitat degradation caused by private land development at Three Lakes (56 FR 37668 37671, August 8, 1991) (USFWS, 2011b).

Regionally, this species can be found in Arizona and Utah. In Arizona, it is found in Coconino County, in the northern part of the state (USFWS, 2015bo). There are only two known natural populations of this species in the United States, which are located in Vasey's Paradise, Arizona and Three Lakes, Utah. Suitable habitat for the Kanab Ambersnail consists of marshes and other wetland areas that are watered by springs and seeps. These snails are hermaphroditic and are found in association with monkeyflower, watercress, and sedges. The primary threat associated with the Vasey's Lake population of the species is controlled flooding of the Colorado River. Recreational users of the area do not disturb the snail population due to large amounts of poison ivy (*Toxicodendron rydbergii*); although poison ivy is not part of the snail's habitat, its presence results in avoidance by recreational users of the area. The introduced population of the Kanab Ambersnail, in Upper Elves Canyon, is a very remote site not typically visited by humans. (USFWS, 2011b)

San Bernardino Springsnail. The San Bernardino springsnail is a small aquatic snail with a narrow cone-shaped shell with spirals that reaches from 0.05 to 0.07 inches in height. The shell opening is egg-shaped and a light amber color. Its nose is pale to gray-black in color, with a pale foot and neck. It is distinguished from other springsnails by the male genitalia, which is smaller, with a continuous transition between the penis base and filament. The San Bernardino springsnail was federally listed as threatened in 2012 (77 FR 23060 23092, April 17, 2012) (Figure 3.1.6-3) (USFWS, 2015bq). Critical habitat was designated at time of listing in approximately 2 acres of Cochise County, Arizona (USFWS, 2012e).

Regionally, this species can be found in Arizona and Mexico. In Arizona, it is found on the privately owned Slaughter Ranch in Cochise County, in the southeastern corner of the state (USFWS, 2015bq). It inhabits springs, seeps, spring runs, and a variety of waters, but is usually found in spring systems that produce running water. Threats to the San Bernardino springsnail include habitat destruction or modification due to the use of fire retardant chemicals to fight wildfires, springhead inundation, climate change, and water depletion or diversion. Additionally were the invasive New Zealand mudsnail to spread into Arizona, they could "outcompete and replace native springsnails" (USFWS, 2012e).

Three Forks Springsnail. The Three Forks springsnail is an aquatic snail with an egg to conical-shaped shell with spirals that reaches 0.05 to 0.18 inches in height (USFWS, 2012e). The Three Forks springsnail was federally listed as endangered in 2012 (77 FR 23060 23092, April 17, 2012). Critical habitat was designated at time of listing in approximately 17.2 acres of Apache County, Arizona (Figure 3.1.6-3) (USFWS, 2012f).

This species can only be found in Apache and Greenlee counties, eastern Arizona (USFWS, 2015br). It usually inhabits spring systems that produce running water at an elevation of approximately 8,000 feet; it is also found in springs, seeps, spring runs, and a variety of waters over substrates of cobble, gravel, woody debris, and aquatic vegetation, which are necessary for laying eggs and feeding. Threats to the Three Forks springsnail include habitat destruction or modification due to soil erosion, wildfires, elk wallowing, drought, non-native crayfish predation, and climate change (USFWS, 2012e) (USFWS, 2012f).

Plants

There are 14 endangered and 7 threatened plant species federally listed in Arizona as summarized in Table 3.1.6-9. The San Francisco Peaks ragwort (*Packera franciscana*) and the Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*) occur in northern Arizona. The Fickeisen Plains cactus (*Pediocactus peeblesianus fickeiseniae*), Gierisch mallow (*Sphaeralcea gierischii*), Holmgren milk-vetch (*Astragalus holmgreniorum*), Jones cycladenia (*Cycladenia humilis var. jonesii*), and the Siler pincushion cactus (*Pediocactus sileri*) occur in northwestern Arizona. The Brady pincushion cactus (*Pediocactus bradyi*), Navajo sedge (*Carex specuicola*), Welsh's milkweed (*Asclepias welshii*), and the Zuni fleabane (*Erigeron rhizomatus*) occur in northeastern Arizona. The Arizona hedgehog cactus (*Echinocereus triglochidiatus var. arizonicus*) and the Peebles Navajo cactus (*Pediocactus peeblesianus var. peeblesianus*) occur in central Arizona. The Acuna cactus (*Echinomastus erectocentrus var. acunensis*), Canelo Hills ladies'-tresses (*Spiranthes delitescens*), Huachuca water-umbel (*Lilaeopsis schaffneriana var. recurve*), Kearney's blue-star (*Amsonia kearneyana*), Nichol's Turk's head cactus (*Echinocactus horizonthalonius var. nicholii*), and the Pima pineapple cactus (*Coryphantha scheeri var. robustispina*) occur in southern Arizona. The Cochise pincushion cactus (*Coryphantha robbinsiorum*) occurs in southeastern Arizona. The Arizona cliff-rose (*Purshia subintegra*) occurs throughout Arizona. The Wright's marsh thistle (*Cirsium wrightii*) is a candidate species in Arizona. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Arizona is provided below.

Table 3.1.6-9: Federally Listed Plant Species of Arizona

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Acuna Cactus	*Echinomastus erectocentrus var. acunensis*	E	No	Valleys and on small knolls and gravel ridges of up to 30 percent slope.
Arizona Cliff-rose	*Purshia subintegra*	E	No	Gentle to steep slopes, open basins, and limestone edges and outcrops on sparsely vegetated landscape that is dissected by ephemeral drainages.
Arizona Hedgehog Cactus	*Echinocereus triglochidiatus var. arizonicus*	E	No	Rugged steep-walled canyons, in narrow cracks between boulders on ridges, scattered on open slopes, as well as among shrubby vegetation within desert grassland.
Brady Pincushion Cactus	*Pediocactus bradyi*	E	No	Desert scrub communities in one specific soil type.
Canelo Hills Ladies'-tresses	*Spiranthes delitescens*	E	No	Mid-elevation wetland communities in fine-grained, highly organic, but well-drained moist soils near springs, seeps, wet meadows, and small streams.
Cochise Pincushion Cactus	*Coryphantha robbinsiorum*	T	No	One type of high-calcium limestone outcrop in the Mexican Highland semi-desert grassland community at elevations of 4,200 feet.
Fickeisen Plains Cactus	*Pediocactus peeblesianus fickeiseniae*	E	No	The Plains and Great Basin grasslands and Great Basin desert scrub vegetation communities on shallow soils derived from exposed layers of Kaibab limestone.
Gierisch Mallow	*Sphaeralcea gierischii*	E	Yes; Starvation Point and Black Knolls in Mohave County, northwestern Arizona.	Gypsum outcrops associated with the Harrisburg Member (topmost geologic layer) of the Kaibab Formation, within warm desertscrub (Mohave desertscrub) plant community.
Holmgren Milk-vetch	*Astragalus holmgreniorum*	E	Yes; in Mohave County, Arizona.	Elevations between 2,480 and 2,999 feet in soils with small stone and gravel deposits on the skirt edges of hill and plateau formations that are a little above or at the edge of drainage areas that drain to the Santa Clara and Virgin Rivers.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Huachuca Water-umbel	*Lilaeopsis schaffneriana var. recurva*	E	Yes; in Cochise and Santa Cruz counties, Arizona.	Cienegas, springs, and other riverine systems.
Jones Cycladenia	*Cycladenia humilis var. jonesii*	T	No	Gypsum-rich, salty soils in plant communities of mixed desert scrub, juniper, or wild buckwheat-Mormon tea at elevations of 4,390 to 6,000 feet.
Kearney's Blue-star	*Amsonia kearneyana*	E	No	Steep, dry, and open woodland-dominated slopes; canyon bottoms are a secondary habitat. Found in Pima County, southern Arizona.
Navajo Sedge	*Carex specuicola*	T	Yes; on the Navajo Indian reservation in Coconino County, Arizona.	Moist soil in shallow caves on sandstone cliffs at elevations of 4,200 to 7,600 feet in pinon-juniper woodland communities.
Nichol's Turk's Head Cactus	*Echinocactus horizonthalonius var. nicholii*	E	No	Elevations between 2,400 and 4,000 feet on limestone substrates along dissected alluvial fans, inclined terraces and saddles, bajadas, and debris flows.
Peebles Navajo Cactus	*Pediocactus peeblesianus var. peeblesianus*	E	No	Level areas or gentle slopes with specialized and localized soils of mixed alluvium in the Gypsiorthids-Torriothents-Haplargids Association.
Pima Pineapple Cactus	*Coryphantha scheeri var. robustispina*	E	No	Alluvial basins and hillsides in semi-desert grasslands, Sonoran desert scrub, and the transition area between the two, at approximately 2,300 to 4,500 feet in elevation.
San Francisco Peaks Ragwort	*Packera franciscana*	T	Yes; in Coconino National Forest, Agassiz Peak, and Humphreys Peak, Coconino County, Arizona.	Alpine tundra on talus slopes above 11,000 feet in elevation.

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Arizona	Habitat Description
Sentry Milk-vetch	*Astragalus cremnophylax var. cremnophylax*	E	No	Crevices and cracks with shallow gravelly soils on large flat platforms of Kaibab limestone bedrock on canyon rims within pinon-juniper woodlands.
Siler Pincushion Cactus	*Pediocactus sileri*	T	No	Elevations of 2,800 to 5,400 feet on gypsum soils in the Great Basin Desert Shrub Biotic Community.
Welsh's Milkweed	*Asclepias welshii*	T	No	Unstable aeolian sand on active sand dunes in plant communities mostly consisting of sand, but also including groves of ponderosa pine and Gambel oak.
Zuni Fleabane	*Erigeron rhizomatus*	T	No	Fine textured clay hillsides with mid to low elevation mountain slopes derived from Chinle or Baca Formations.

Source: (USFWS, 2015e)

[a] E = Endangered, T = Threatened

Acuna Cactus. The acuna cactus (*Echinomastus erectocentrus var. acunensis*) is a small, spherical cactus, reaching up to 12 inches or 30 centimeters in height, that typically has a single plump stem, straight central spine, and rose, pink, or lavender flowers produced in March (USFWS, 2015ab). The acuna cactus was listed as an endangered species with proposed critical habitat in 2013 (78 FR 60607 60652, October 1, 2013); a final rule on critical habitat designation has not been published as of June 2016. Five known Acuna cactus population areas come from southern Arizona, in Maricopa, Pima, and Pinal Counties, as well as from Sonora, Mexico near the U.S border (USFWS, 2013e). Populations are from lands owned primarily by the National Park Service and Bureau of Land Management with additional sites on DoD, Arizona State Lands, Tohono O'odham Nation, and private lands (USFWS, 2015ab).

"The acuna cactus occurs in valleys and on small knolls and gravel ridges of up to 30 percent slope," although "the plant is not found on all seemingly suitable habitat" due to "microclimate (soil structure, chemistry, and moisture) factors." Threats to the species are primarily from long-term drought, effects of climate change, ongoing and future U.S-Mexico border activities, and future nonnative, invasive species issues (USFWS, 2013e) (USFWS, 2015ab).

Arizona Cliff-rose. The Arizona cliff-rose (*Purshia subintegra*) "is a low, straggling woody perennial" usually 3 to 6 feet in height. "New shoots tend to be red-brown… with a red dot below the fascicle, while "older branches have light gray bark that becomes shreddy" (USFWS, 1995c). The Arizona cliff-rose was listed as an endangered species without designated critical habitat in 1984 (49 FR 22326 22329, May 29, 1984) (USFWS, 2015ba). It is known from four distinct populations on the northern edge of the Sonoran Desert that occur along a 200-mile wide area of Central Arizona. The species occurs on Bureau of Land Management, Bureau of Indian Affairs lands, or Arizona State lands administered by the AZDOT (USFWS, 1995c).

The "Arizona cliff-rose grows on gentle to steep slopes, open basins, and limestone ledges and outcrops" on sparsely vegetated landscape that is dissected by ephemeral drainages. Threats to the species are primarily from overgrazing, poor reproduction, mining activities, urbanization, pesticides, maintenance of road and pipeline right-of-ways, and inundation (USFWS, 1995c).

Arizona Hedgehog Cactus. Arizona Hedgehog cactus (*Echinocereus triglochidiatus var. arizonicus*) is a large succulent perennial, up to 16 inches in height, with dark green cylindroid stems occurring singly or most often in clusters, and red and yellow flowers. Arizona Hedgehog cactus was listed as an endangered species without designated critical habitat in 1979 (44 FR 61556 61558, October 25, 1979). Population range includes Pinal and Gila counties within Central Arizona, including Pinal, Dripping Springs, Superstition, and Mescal mountains, and in the highlands between Globe and Superior (AZGFD, 2003b).

Arizona Hedgehog cactus are found on rugged steep-walled canyons, in narrow cracks between boulders on ridges, scattered on open slopes, as well as among shrubby vegetation within desert grassland. The major threat to the species would be habitat loss due to mining (AZGFD, 2003b).

Brady Pincushion Cactus. Brady Pincushion cactus (*Pediocactus bradyi*) is a small seimglobose cactus which reaches 2 inches in diameter and 2.5 inches in height, with yellow flowers and brown mature fruit. The species was listed as endangered without designated critical habitat in 1979 (44 FR 61784 61786, October 26, 1979). The range of this species is very small; it occurs in only one small area adjacent to a major highway and recreation area in Coconino County on BLM and NPS land (USFWS, 1979a).

Brady Pincushion cactus occur in desert scrub communities and are restricted to one specific soil type. Major treats to the species include removal of plants by private collectors and commercial suppliers, highway and powerline maintenance and construction, off-road vehicle use, and grazing (USFWS, 1979a).

Canelo Hills Ladies'-tresses. Canelo Hills ladies'-tresses (*Spiranthes delitescens*) is a slender, erect, perennial terrestrial orchid with a spiral cluster of small white flowers that reaches approximately 20 inches in height. Canelo Hills ladies'-tresses was listed as endangered without designated critical habitat in 1997 (62 FR 665 689, January 1, 1997) (USFWS, 2015ad). The species is known from five sites in the San Pedro River watershed in Santa Cruz and Cochise Counties in southern Arizona. Four of the populations are located on private land north of the United States-Mexico border, and one small site is located on public Coronado National Forest land. Potential habitat may also exist in Sonora, Mexico (USFWS, 1997b).

The Canelo Hills ladies'-tresses orchid occurs at mid-elevation wetland communities in fine-grained, highly organic but well-drained moist soils near springs, seeps, wet meadows, and small streams. Threats to this species are from surface and groundwater habitat destruction due to development, livestock grazing, watershed erosion, invasive species, and habitat trampling (USFWS, 2015ad).

Cochise Pincushion Cactus. Cochise pincushion cactus (*Coryphantha robbinsiorum*) is small unbranched cactus, typically not more than 1.5 cm tall and 4 cm wide. The cactus is characterized by thin, white spines extending radially from cotton-like areoles. The species was federally listed as threatened without designated critical habitat in 1986 (51 FR 952 956, January 9, 1986) (USFWS, 2015af). The known range for the species is very small and limited on several isolated hills within state and private lands in Cochise County. A population in adjacent Sonora, Mexico, is also known to exist (USFWS, 1986).

Cochise pincushion cactus are "found only on one type of high-calcium limestone outcrop in the Mexican Highland" semi-desert grassland community at elevations of 4,200 feet (USFWS, 2015af). "Soils are thin with a crust of lichens, mosses, and algae, and bedrock is very near the surface" (USFWS, 2015af). Threats to this species are from ground disturbing activities such as vehicle use, livestock trampling, and hiking, as well as drought and over collection. Insect predation (moths and beetles) is a significant cause of mortality (USFWS, 1986).

Fickeisen Plains Cactus. Fickeisen Plains cactus (*Pediocactus peeblesianus fickeiseniae*) is "a small cactus, approximately 3 inches tall and 1.5 inches in diameter," with small cream, yellow, or yellowish-green flowers during blooming. It has corky spines with tubercles that form a spiral pattern around the plant. Fickeisen Plains cactus was listed as endangered without designated critical habitat in 2013 (78 FR 60607 60652, October 1, 2013). The species range encompasses the Arizona Strip,[110] and it occurs in widely scattered, small populations on the Colorado Plateau in Coconino and Mohave counties (USFWS, 2015ah).

The Fickeisen Plains cactus occurs within Plains and Great Basin grasslands and Great Basin desert scrub vegetation communities on shallow soils derived from exposed layers of Kaibab limestone. Most populations grow at mid-elevation on "canyon rims, on flat terraces or benches, or on the toe of well-drained hills with less than 20 percent slope." Threats to the species include trampling by livestock, nonnative invasive species, herbivore, drought, and climate change (USFWS, 2015ah).

Gierisch Mallow. Gierisch mallow (*Sphaeralcea gierischii*) a perennial, flowering plant that produces dark red-purple stems and orange flowers from a woody base. Gierisch mallow was listed as endangered with designated critical habitat in 2013 (78 FR 49149 49165, August 13, 2013). The species is found only in northern Mohave County, Arizona and adjacent Washington County, Utah. Known populations are located in the Black Knolls area within the vicinity of the Arizona-Utah state line (Figure 3.1.6-3) (USFWS, 2015aj).

Gierisch mallow is found only on gypsum outcrops associated with the Harrisburg Member (topmost geologic layer) of the Kaibab Formation, within warm desertscrub (Mohave desertscrub) plant community. Threats to the species include habitat destruction and modification from mining operations, recreational activities, and wildfires associated with the spread of nonnative grass species (USFWS, 2013f).

Holmgren Milk-vetch. The Holmgren milk-vetch is a perennial, non-woody herbaceous member of the pea family. It grows close to the ground with its leaves growing directly out of the root crown (USFWS, 1999). The leaves are 1.5 to 5.1 inches long with 9 to 15 oval-shaped leaflets 0.3 to 0.6 inches in length, tapering towards the base of the leaf. It grows small five-petaled purple flowers in the spring that are 0.7 to 0.9 inches long and 0.2 to 0.4 inches wide

[110] The area in northwest Arizona, north of the Colorado River, is known as the Arizona Strip (BLM, 2014b).

found along the stalk in groups of 6 to 16. This species produces fruit pods that are 1 to 2 inches long and 0.2 to 0.4 inches wide that eventually dry out with age and open up at the top and bottom. The Holmgren milk-vetch was federally listed as endangered in 2001 (66 FR 49560 49567, September 28, 2001). Regionally, this species is found in Arizona and Utah. In Arizona, it can be found in Mohave County, in the northwestern corner of the state (USFWS, 2015al).

Critical habitat in Arizona (Mohave County) was established in 2006 (Figure 3.1.6-3) (71 FR 77972 78012, December 27, 2006) (USFWS, 2006b). Holmgren milk-vetch is thinly distributed in elevations between 2,430 and 3,000 feet in soils, with small stone and gravel deposits on the plateau formations at the edge of drainage areas with hydrological conditions provided by surface or subsurface runoff. Threats to this species include land development, urban expansion, and invasive plant species (USFWS, 2006b).

Huachuca Water-umbel. The endangered Huachuca water-umbel (*Lilaeopsis schaffneriana var. recurva*) “is a semi-aquatic to full aquatic herbaceous perennial in the carrot family.” The length of the leaves vary from about 1in. to almost 13 inches (USFWS, 2015ao). The Huachuca water-umbel was federally listed as endangered in 1997 (62 FR 665 689, January 06, 1997). The last remaining U.S. population of the Huachuca water-umbel are found within the following three counties in Arizona; Santa Cruz, Cochise, and Pima counties. This plant is also known to occur in few areas in the northern region of Sonora, Mexico, along the border with Arizona (County, 2015). In 1999, critical habitat was designated in Cochise and Santa Cruz counties (Figure 3.1.6-3) (64 FR 37441 37453, July 12, 1999).

Suitable habitat for the Huachuca water-umbel consist of springs and other riverine systems because this species relies heavily on intermediate flooding as they usually grow 2 to 6 inches under water and benefit from the organic content in the muddy substrates. The Huachuca water-umbel has the availability to reproduces sexually through seed and asexually through rhizomes. The major threat to the survival of the Huachuca water-umbel is the surface and groundwater withdrawal. Additional threats to its survival include degradation of suitable habitats from increased runoff that fill or cover habitats with excess sediment and the expansion of non-native plant species (USFWS, 2015ao).

Jones Cycladenia. The Jones cycladenia is a perennial herbaceous herb that grows about 4 to 14 inches tall. It has a long underground stem system, oval-shaped leaves and grows pink or rose-colored flowers that are trumpet-shaped and resemble small morning glories (USFWS, 2008b). The Jones cycladenia was federally listed as threatened in 1986 (51 FR 16526 16530, May 5, 1986). Regionally, this species is found in Arizona and Utah. In Arizona, it can be found in Mohave County, in the northwestern corner of the state (USFWS, 2015ap).

It inhabits gypsum-rich, salty soils in plant communities of mixed desert scrub, juniper, or wild buckwheat-Mormon tea at elevations of 4,390 to 6,000 feet. Threats to the Jones cycladenia include off-road vehicle use; oil, gas, and mineral exploration; and livestock grazing (USFWS, 2008b).

Kearney's Blue-star. The Kearney's blue-star (*Amsonia kearneyana*) is an herbaceous perennial that stands up to 2.3 feet in height at maturity. It has erect pubescent (hairy) stems, lance-shaped bright green leaves, and terminal pale blue flower clusters (USFWS, 1993b). Kearney's blue-star was listed as an endangered species without designated critical habitat in 1989 (54 FR 2131 2134, January 19, 1989) (USFWS, 2015ar). Limited species populations are found in south-central Arizona. Subpopulations occur on lands administered by the Tohono O'odham Nation, the Arizona State Land Department, and the Bureau of Land Management. An ex-situ population was created in 1988 on land now administered by the USFWS as part of the Buenos Aires NWR (USFWS, 2013g).

Most subpopulations are located on steep, dry, and open woodland-dominated slopes, and canyon bottoms are a secondary habitat. Threats to the species include catastrophic flooding and soil erosion accelerated by losses in plant cover and vigor due to livestock grazing, seed predation by insects, low numbers and few populations, and insufficient reproduction, as well as climate change, fire, and U.S-Mexico border activity (USFWS, 2013g).

Navajo Sedge. Navajo sedge "is a grass-like, slender perennial forb in the sedge family." The stems are 6 to 20 inches long, not upright, and generally longer than the leaves. Many of the stems grow from an underground stem, which gives the plant a clumped shape, often forming mats with a dried leaf base. The flowers are male and female, with male flowers growing on the end of the stem, and female flowers growing below (USFWS, 2014m). The Navajo sedge was federally listed as threatened in 1985 (50 FR 19370 1937, May 8, 1985). Regionally, this species is found in Arizona and Utah. In Arizona, it can be found in Apache, Coconino, and Navajo counties, in the northeastern part of the state (USFWS, 2015at). Critical habitat was designated at time of listing on the Navajo Indian reservation in Coconino County, Arizona (USFWS, 1985b).

The Navajo sedge inhabits moist soil in shallow caves on sandstone cliffs at elevations of 4,200 to 7,600 feet in pinon-juniper woodland communities. Threats to the Navajo sedge include livestock trampling, water withdrawals from Colorado Basin aquifers and occupied springs, as well as the potential of increased temperature and altered precipitation patterns due to climate change. (USFWS, 2014m)

Nichol's Turk's Head Cactus. Nichol's Turk's head cactus (*Echinocactus horizonthalonius var. nicholii*) is a small, single-stemmed, blue-green to gray-green barrel cactus that is between 16 to 20 inches in height and 5 to 8 inches in width. Flowers, approximately 1.5 to 2.7 inches in diameter, are situated at the top of the stem and are pink to red in color. The cactus was listed as an endangered species without designated critical habitat in 1979 (44 FR 61927 61929, October 26, 1979). Endemic to the Sonoran Desert, the cactus occurs in isolated mountainous areas in Maricopa, Pima, and Pinal counties and Sonora, Mexico. There are currently four known discrete populations in the Waterman Mountains on the Tohono O'odham Nation, and in the Sierra del Viejo Mountains (USFWS, 2015av).

The Nichol's Turk's head cactus is found at an elevation of between 2,400 and 4,000 feet on limestone substrates along dissected alluvial fans, inclined terraces and saddles, bajadas, and debris flows. The cactus grows in open to partially shaded areas, including limestone outcrops. Threats to the species include mining, use of recreational off-road vehicles, the spread of invasive species, "drought, and habitat disturbance in association with border and law enforcement activities" (USFWS, 2015av).

Peebles Navajo Cactus. Peebles Navajo cactus (*Pediocactus peeblesianus var. peeblesianus*) is a very small, approximately 1 inch in height and 0.74 inches in diameter, spherical cactus with rarely clustered, solitary stems and yellow to yellow-green flowers. The cactus was listed as an endangered species without designated critical habitat in 1979 (44 FR 61922 61924, October 26, 1979). It occurs in a very small geographic area in the immediate vicinity of Joseph City and Holbrook, Arizona in Navajo County (USFWS, 2015ax).

The Peebles Navajo cactus has a narrow range, limiting it to "level areas or gentle slopes with specialized and localized soils… of mixed alluvium in the Gypsiorthids-Torriothents-Haplargids Association" (USFWS, 2015ax)(USFWS, 1979b). Threats to the species includes habitat destruction from off road vehicle use, livestock grazing, and non-native species (USFWS, 2015ax).

Pima Pineapple Cactus. Pima pineapple cactus (*Coryphantha scheeri var. robustispina*) is a low-growing, approximately 4- to 18-inches tall and 3- to 7-inches in diameter, single or multi-stemmed cactus with yellow flowers. It has stout and clustered spines that are originally straw-colored, becoming black with age. The Pima pineapple cactus was listed as an endangered species without designated critical habitat in 1993 (58 FR 49875 49880, September 23, 1993) (USFWS, 2015az). This species is known from Pima and Santa Cruz Counties, in southern Arizona, and northern Sonora, Mexico. The range extends east from the Baboquiveri Mountains to the western foothills of the Santa Rita Mountains. The northernmost boundary is near Tucson (USFWS, 1993c).

The Pima pineapple cactus occurs in alluvial basins and hillsides in semi-desert grasslands, Sonoran desert scrub, and the transition area between the two, at approximately 2,300 to 4,500 feet in elevation (USFWS, 1993c). It is most commonly found on open areas on flat ridge-tops or slopes of less than 10 to 15 percent (USFWS, 2015az). Threats to the species include "ground disturbing activities that remove or degrade natural vegetation cover, including mining, livestock grazing, and urban/exurban development that also fragments remaining habitat areas," as well as "expansion of non-native invasive plants, predation by insects and small mammals, and extended drought" (USFWS, 2015az).

San Francisco Peaks Ragwort. The San Francisco Peaks ragwort (*Packera franciscana*) is a dwarf alpine plant and member of the sunflower family. This plant grows from one to four inches tall with a yellow-gold flower at the end of each stem (USFWS, 2015bb). The San Francisco Peaks ragwort was federally listed as threatened with designated critical habitat in 1983 (48 FR 52743 52747, November 22, 1983). It is only known to occur "on the talus[111] slopes in the alpine zone on the San Francisco Peaks in Coconino County, Arizona" (USFWS, 2015bf).

[111] Talus: "An accumulated mass of rock fragments (broken rock formed by falling, rolling, or sliding) of various sizes derived from and lying at the base of a steep slope" (NPS, 2016m).

Suitable habitats for the San Francisco Peaks ragwort include alpine tundra on talus slopes between 10,900 feet and 12,400 feet in elevation. Its growth in clustered groups indicate that this plant reproduces via rhizomes; however, it can also reproduce sexually through seed (USFWS, 2015bf). Threats to its survival include climate change and surface disturbance from hiking, skiing, and other recreational activities (USFWS, 2015bb).

Sentry Milk-vetch. The Sentry milk-vetch (*Astragalus cremnophylax var. cremnophylax*) is a dwarf milk-vetch, approximately 1 inch in height, that forms a mat up to 10 inches in diameter, with silvery-haired leaves and stems and pale, purplish-pink flowers with white-tipped wings (USFWS, 1990b). The Sentry milk-vetch was listed as an endangered species without designated critical habitat in 1990 (55 FR 50184 50187, December 5, 1990). The species is known to exist in three locations on the South Rim of Grand Canyon National Park in Coconino County (USFWS, 2006c).

The Sentry milk-vetch occurs in crevices and cracks with shallow gravelly soils on large flat platforms of Kaibab limestone[112] bedrock on canyon rims within pinon-juniper woodlands. Threats to the species include previous trampling by park visitors, habitat destruction and modification, low reproductive potential, and drought (USFWS, 1990b) (USFWS, 2006c).

Siler Pincushion Cactus. Siler Pincushion cactus (*Pediocactus sileri*) is “a globose or cylindrical cactus,” approximately 4 to 5 inches in height, with gray spines and yellow flowers. The species was federally listed as an endangered species in 1979 (44 FR 61786 61788, October 26, 1979) and reclassified to threatened status without designated critical habitat in 1993 (58 FR 68476 68480, December 27, 1993). The species occurs in southwestern Utah and northwestern Arizona (USFWS, 1993d).

Siler Pincushion cactus are most commonly found at elevations of 2,800 to 5,400 feet on gypsum soils in communities with desert shrub, sagebrush, and pinyon-juniper forest and rangeland (AZGFD, 2003c). Threats to the species includes development, off-highway vehicle use, road construction, illegal collection, and livestock grazing (USFWS, 1993d).

Welsh's Milkweed. The Welsh's milkweed is a tall, herbaceous plant with stems that up to 40 inches tall. It can grow alone or in clusters of about 10 stems from roots that have runners connecting the clusters. The leaves grow in opposite pairs along the stems, with larger upper leaves (3 inches long and 2 inches wide) above smaller lower leaves. The leaves and stems are covered in dense white colored wooly hairs early in the growing season, but by the end of the season these hairs are rubbed off by blowing sand. There are about 30 cream-colored flowers with a rose-tinted center that grow in a circular pattern about 3 inches wide at the end of a small stalk. The seeds are large for the milkweed family, reaching about 1 inch long (USFWS, 1992). The Welsh’s milkweed was federally listed as threatened in 1987 (52 FR 41435 41441; October 28, 1987). Regionally, this species is found in Arizona and Utah. In Arizona, it can be found in Apache, Coconino, and Navajo counties, in the northeastern portion of the state (USFWS, 2015bh).

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[112] Kaibab Limestone is impure cherty limestone. It ranges in color and may be gray, buff, yellowish brown, or brown. (University of Utah, 2010)

It is found “on aeolian sand dunes in a plant community dominated by sand mulesears (*Wvethia scabrida* var. *attenuata*) with prominent groves of ponderosa pine (*Pinus ponderosa*) and clumps of Gambel oak (*Quercus gambelii*)” (USFWS, 1992).

The surrounding habitat consists of stabilized sands with vegetation, sandstone, or different exposed shales or other fine grained exposed rocks types. The greatest threat to the Welsh’s milkweed is habitat destruction due to off-road vehicle use. (USFWS, 1992)

Zuni Fleabane. The threatened Zuni fleabane (*Erigeron rhizomatus*) is an herbaceous perennial in the aster family. The Zuni fleabane grows stems ranging from seven to 17 inches with flowers with a yellow disc and white or blue-violet tinged ray petals (New Mexico Rare Plant Technical Council, 2005). The Zuni fleabane was federally listed as threatened in 1985 (50 FR 16680 16682, April 24, 1985). It is only known to occur in regions along the border of Arizona and New Mexico, on fine textured clay hillsides with mid to low elevation mountain slopes in the Chuska Mountains. In Arizona, it is known to occur only in Apache County. The major threat to the survival of the Zuni fleabane is surface disturbance from the potential of uranium mines in the region, additionally habitat disturbance from cattle grazing and development. (USFWS, 2005)

3.1.7. Land Use, Recreation, and Airspace

3.1.7.1. Definition of the Resources

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

Land Use, Recreation, and Airspace

Land use is defined as “the arrangements, activities, and inputs people undertake in a certain land cover type to produce, change, or maintain it” (Di Gregorio & Jansen, 1998). A land use designation can include one or more pieces of land, and multiple land uses may occur on the same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth's surface; land cover includes vegetation and manmade development (USGS, 2012b).

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

Descriptions of land uses are presented in three primary categories: semi-desert, forest and woodlands, shrubland and grassland, agricultural, and developed. Descriptions of land ownership are presented in four main categories: private, federal, state, and tribal. Descriptions of recreational opportunities are presented in a regional fashion, highlighting areas of recreational significance within four identified regions (Arizona State Parks, 2009).

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 and Aeronautical Center, etc.) assist in regulating civil aviation to promote safety, and develop and carry out programs that control aircraft noise and other environmental effects (e.g., air pollutants) attributed from civil aviation (FAA, 2015b). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

3.1.7.2. Specific Regulatory Considerations

Land use planning in Arizona is the primary responsibility of local governments (i.e., county). The main planning tools for local governments include the comprehensive plan, zoning ordinance, and subdivision ordinance. The land use code for each county sets forth the authority for each of these tools, as granted to the counties by state-enabling legislation. The comprehensive plan proposes land uses and locations of public facilities and utilities and projects long-term population growth. The zoning ordinance sets forth the rules used to govern the land by dividing localities into zoning districts and establishes allowable uses within the districts (e.g., agriculture, industry, commercial use). The subdivision ordinance manages the process for dividing large land parcels into smaller lots.

Because the Nation's airspace is governed by federal laws, there are no specific Arizona state laws that would alter the existing conditions relating to airspace for this PEIS. However, there are Arizona state statutes that address the safety of the airspace and flight safety at public airports and obstruction to airspace considerations as addressed in the Arizona Revised Statutes, Aviation, Title 28, Chapter 25 Aviation, Article 7, Airport Zoning and Regulation (Arizona State Legislature, 2015c).

3.1.7.3. Land Use and Ownership

For the purposes of this analysis, Arizona is classified into land use groups based on coverage types as semi-desert, forest and woodland, shrubland and grassland, developed land, agricultural land, and public land/surface water/other land covers. Land ownership within Arizona is classified into four main categories: private, federal, state, and tribal land currently located in the state.

Land Use

Table 3.1.7-1 identifies the major land uses by coverage type in Arizona. Semi-desert comprises the largest portion of land (61 percent), followed by forest and woodland (27 percent) in Arizona. The other major land uses—shrubland and grassland, agricultural, and developed land—each have small percentages of total land area (Table 3.1.7-1 and Figure 3.1.7-1). The remaining percentage of land includes public land, surface water, and other land cover, shown in Figure 3.1.7-1, that are not associated with specific land uses (USGS, 2011b).

Table 3.1.7-1: Major Land Uses in Arizona by Coverage Type

Land Use	Square Miles	Percent of Land
Semi-Desert	69,086	61%
Forest and Woodland	30,708	27%
Shrubland and Grassland	4,820	4.2%
Developed Land	2,403	2%
Agricultural Land	2,175	2%
Other	4,402	4%

Source: (USGS, 2011b)

Semi-Desert

Land use within the semi-desert category in Arizona includes conservation areas, wilderness and wilderness study areas, recreation, minerals development, wild horse management areas, and livestock grazing (BLM, 2015a) (BLM, 2015b) (BLM, 2015c) (BLM, 2016a). Semi-desert areas cover over 60% of Arizona's land (Figure 3.1.7-1) and are managed by private land owners, the state, DOD, DOE, NPS, USFWS, tribes, and the BLM (Figure 3.1.7-2).

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. The largest concentrations of forest are located throughout the north and central portions of the state within the Colorado Plateau geographic region (See Figure 3.1.7-1) (USGS, 2011b). Section 3.1.6 presents additional information about terrestrial vegetation.

National Forests

The six national forests in Arizona comprise approximately 56 percent of the state's total forestland: Kaibab, Coconino, Prescott, Tonto, Apache-Sitgreaves, and Coronado National Forests. These National Forests occur throughout the northern and central portions of the state, covering 17,031 square miles (Figure 3.1.7-2) (USGS, 2011b). The forests are managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat (USFS, 2016a).

State Forests

Although specific stat e forests do not occur in Arizona, the Arizona State Land Department manages 14,500 square miles, some of which are located in the forested areas of the Colorado Plateau regions in northern Arizona. These lands are not public lands, but rather are public trust lands managed to generate revenue for public education. This is accomplished by selling and leasing trust lands for agriculture, grazing, school site, commercial, and open-space purposes (Arizona State Land Department, 2015).

Private Forest and Woodland

Large portions of Arizona's forestland are privately owned (Figure 3.1.7-2). Approximately 15 percent of Arizona's total land base is in private ownership, some of which is located in forest areas. Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and National Forests (Figure 3.1.7-2). For additional information regarding forest and woodland areas, see Section 3.1.6, Biological Resources, and Section 3.1.8, Visual Resources.

Shrubland and Grassland

The largest concentrations of shrubland and grassland are located in mountain valleys, edges of forest and woodlands, and the transition between high and low elevations (Figure 3.1.7-1). Land use in these areas varies by location and includes both private and public land ownership (Figure 3.1.7-2). Some of the uses within this category include ranching, recreation, and wildlife preservation (USFS, 2016a).

Agricultural Land

Agricultural land exists throughout the state on 2,175 square miles, or two percent of the total land area (Figure 3.1.7-1) (USGS, 2011b). In 2012, approximately 20,005 farms exist in Arizona, with an average size of 2.1 square miles (USDA, 2012a). Also in 2012, Arizona's top agricultural products are vegetables, melons, potatoes, and sweet potatoes (21 percent of total agricultural receipts); milk from cows (21 percent of total agricultural receipts); cattle and calves (19 percent of total agricultural receipts); and other crops and hay (11 percent of total agricultural receipts) (USDA, 2012b).

Developed Land

Developed land in Arizona is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 3.1.7-1). Although only 2,403 square miles, or two percent, of Arizona land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 3.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates.

Table 3.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate (2010)
Phoenix-Mesa, AZ	3,629,114
Tucson, AZ	843,168
Avondale-Goodyear, AZ	197,041
Yuma, AZ-CA (AZ Portion)	134,256
Prescott Valley, AZ	84,744
Total Population of Metropolitan Areas	**4,888,323**
Total State Population (2010 Census)	**6,392,017**

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

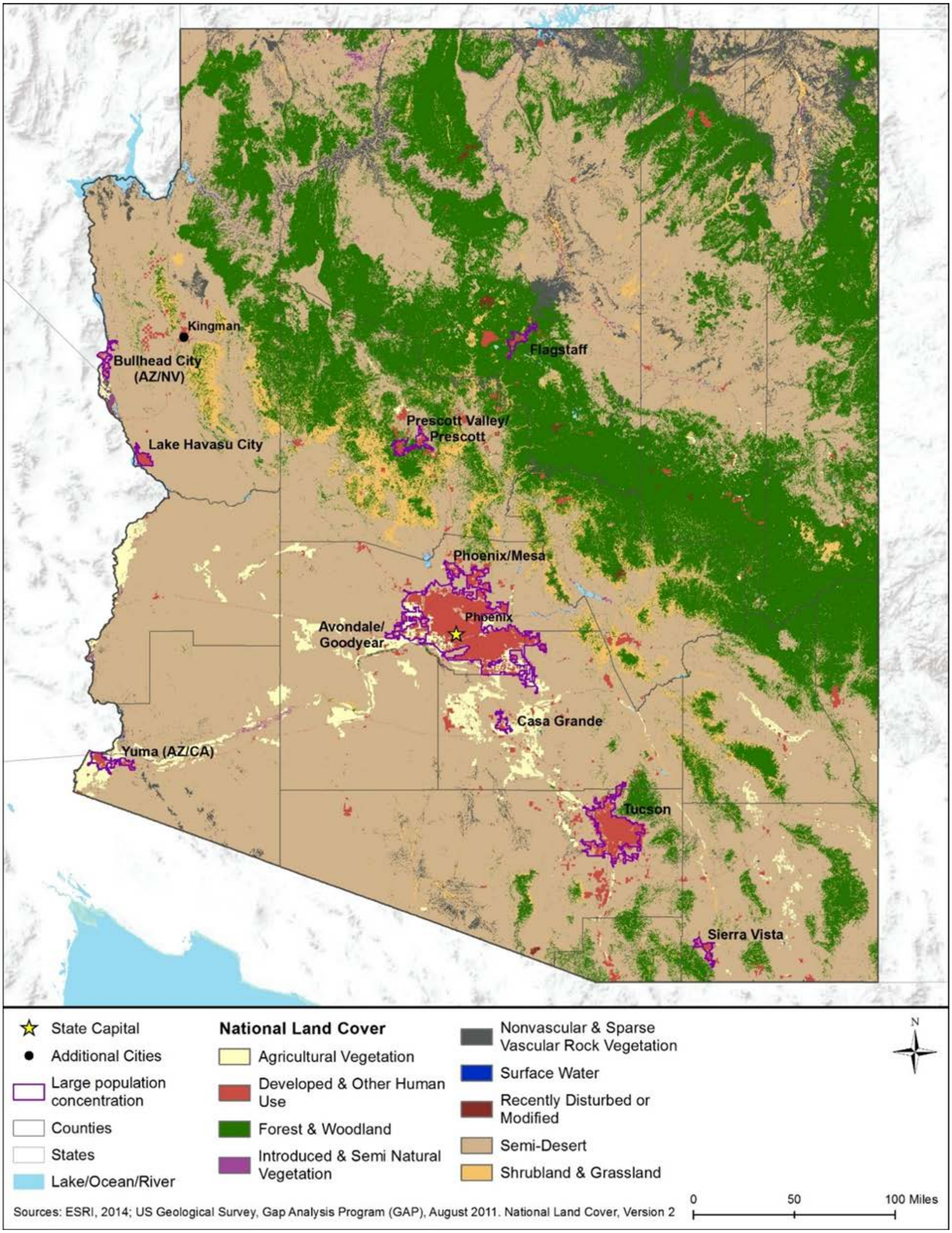

Figure 3.1.7-1: Major Land Use Distribution by Coverage Type

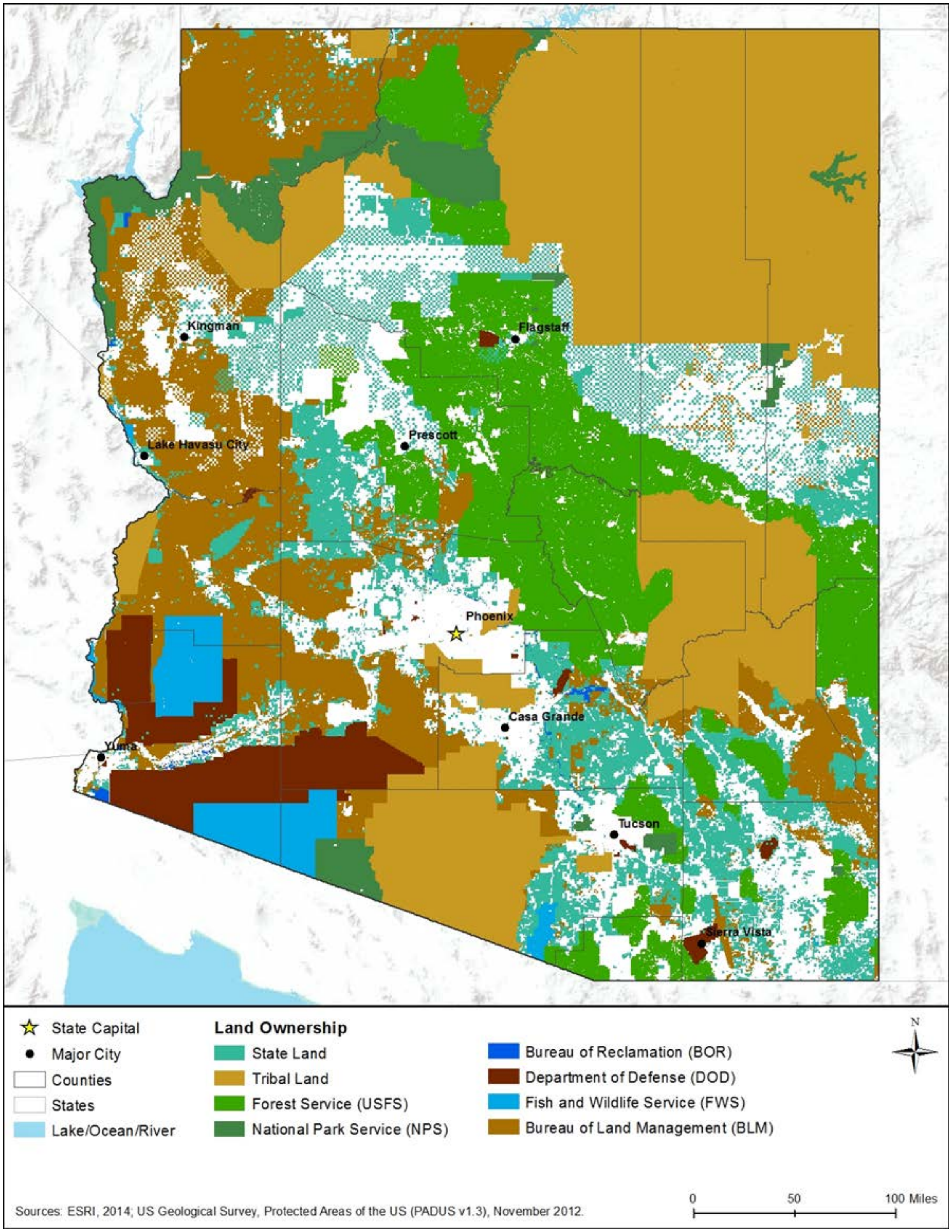

Figure 3.1.7-2: Land Ownership Distribution

Land Ownership

Land ownership within Arizona has been classified into four main categories: private, federal, state, and tribal (Figure 3.1.7-2).[113]

Private Land

The majority of land in Arizona is owned and managed by the federal and state government, with areas of private land scattered throughout the state (Figure 3.1.7-2). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas (Figure 3.1.7-2). Private land exists in all regions of the state. [114]

Federal Land

The federal government manages 48,097 square miles, or approximately 42 percent, of land in Arizona, including NPS units, national wildlife refuges, national forests, and military facilities (Figure 3.1.7-2) (USGS, 2014f) (USGS, 2014e). Six federal agencies manage the majority of federal lands throughout the state (Table 3.1.7-3 and Figure 3.1.7-2) (USGS, 2014f). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.

Table 3.1.7-3: Major Federal Land Ownership Distribution

Agency[a]	Square Miles	Representative Type
Bureau of Land Management	19,331	Forests, National Monuments, and Wilderness
USDA Forest Service	17,031	Forests and Wilderness
Department of Defense	4,401	Military Installations
National Park Service[b]	4,493	National Parks, National Recreation Areas, and Wilderness
U.S. Fish and Wildlife Service	2,674	Wildlife Refuges and Wilderness
Bureau of Reclamation	167	Reservoirs
Total	**48,097**	

Source: (USGS, 2014f)
[a] Table identifies land wholly managed by the Agency; additional properties may be managed by or affiliated with the Agency. Bureau of Indian Affairs land included the *Tribal Land* subsection.
[b] Additional trails and corridors pass through Arizona that are part of the National Park System.

The following is a brief description of federal land ownership in Arizona:

- The Bureau of Land Management manages 19,331 square miles of land comprised of open space (forests, wilderness areas, shrublands/grasslands, and semi-desert areas), the Gila Box Riparian National Conservation Area, and five national monuments (Grand Canyon-

[113] Land ownership data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (http://gapanalysis.usgs.gov/padus/). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive data set that contains large quantities of information relevant to the Proposed Action. The data was queried to show Owner and used USGS' PAD-US ownership symbolization for consistency. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.
[114]Total acreage of private land could not be obtained for the state.

Parashant, Vermillion Cliffs, Agua Fria, Ironwood Forest, and Sonoran Desert) (USGS, 2014f) (BLM, 2016b).
- The USDA Forest Service manages 17,031 square miles of land comprised of six National Forests: Kaibab, Coconino, Prescott, Tonto, Apache-Sitgreaves, and Coronado National Forests (USGS, 2014f).
- The Department of Defense manages 4,401 square miles of land comprised of the Davis-Monthan Air Force Base, Luke Air Force Base, Willcox Dry Lake Bombing Range, Navajo Army Depot (closed), Yuma Proving Ground, Florence Military Reservation, Yuma Marine Corps Air Station, Barry M. Goldwater Air Force Range, Naval Observation Station, Fort Huachuca, and Air Force Plant No. 44 (USGS, 2014f).
- The NPS manages 4,493 square miles of land comprised of 3 National Parks, 2 National Historic Trails, 14 National Monuments, and 2 National Recreation Areas (NPS, 2015c).
- The USFWS manages 2,674 square miles of land comprised of nine national wildlife refuges: Havasu, Bill Williams, Cibola, Imperial, Kofa, Cabeza Prieta, Buenos Aires, Leslie Canyon, and San Bernardino National Wildlife Refuges (USFWS, 2016d).
- The Bureau of Reclamation manages 167 square miles of lakes and reservoirs located throughout the state: Lake Mead, Lake Mohave, Lake Powell, Alamo Lake, Saguaro Lake, Canyon Lake, Theodore Roosevelt Lake, Horseshoe Reservoir, and Barlett Reservoir (USGS, 2014f).

State Land[115]

The Arizona State Land Department manages 14,500 square miles of land, or 13 percent of the total land in the state (Figure 3.1.7-2). These lands were granted to Wyoming in 1912 by the federal government and required to be held in trust and managed by the state. These lands are not public lands, but rather are public trust lands managed to generate revenue for public education. This is accomplished by selling and leasing trust lands for agriculture, grazing, school site, commercial, and open-space purposes (Arizona State Land Department, 2015). Arizona also manages 31 state parks scattered throughout the state, which are available for camping, hiking, biking, boating, fishing, wildlife viewing, and other recreation activities (Arizona State Parks, 2015b).

Tribal Land

Approximately 31,676 square miles, or 28 percent, of land in Arizona is managed by American Indians across 22 reservations held in trust by the Bureau of Indian Affairs (Figure 3.1.7-2 and Table 3.1.7-4) (USGS, 2014f).[116]

[115] 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.
[116] 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 and are sovereign nations.

Table 3.1.7-4: Representative Indian Reservations in Arizona

Indian Reservations	Square Miles
Camp Verde Indian Reservation	0.8
Cocopah Indian Reservation	9.8
Colorado River Indian Reservation	389.8
Fort Apache Indian Reservation	2,633.4
Fort McDowell Indian Reservation	39.0
Fort Mojave Indian Reservation	36.8
Fort Yuma Indian Reservation	3.4
Gila Bend Indian Reservation	602.6
Havasupai Indian Reservation	274.7
Hopi Reservation	2,440.6
Hualapai Indian Reservation	1604.1
Kaibab Indian Reservation	189.3
Maricopa (Ak-Chin) Reservation	33.0
Navajo Reservation	15,972.1
Pascua Yaqui Indian Reservation	1.4
Salt River Reservation	80.8
San Carlos Apache Indian Reservation	2,899.4
San Xavier Indian Reservation	111.6
Tohono O'odham Indian Reservation	4,333.7
Tonto Apache Reservation	0.1
Yavapai Reservation	2.2
Zuni Indian Reservation	17.7
Total	**31,676.3**

Source: (USGS, 2014f)

3.1.7.4. Recreation

Arizona is known for its hot summers and mild winters, as well as its deserts and mountain peaks. Top areas for recreation in the state include the grand vistas of the Grand Canyon National Park and desert locations notable for hiking and backpacking (AZ Office of Tourism, 2016a). Reaching through the state, the Arizona National Scenic Trail extends 820 miles from the Utah border to the Mexican border, through all of the state's terrain, crossing deserts and mountain ranges (BLM, 2015d). On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, indoor and outdoor pools, and dog runs (Tucson Parks and Recreation, 2016a) (Tucson Parks and Recreation, 2016b). Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreational opportunities available at various locations throughout Arizona. For information on visual resources, see Section 3.1.8, Visual Resources, and for information on the historical significance of locations, see Section 3.1.11, Cultural Resources.

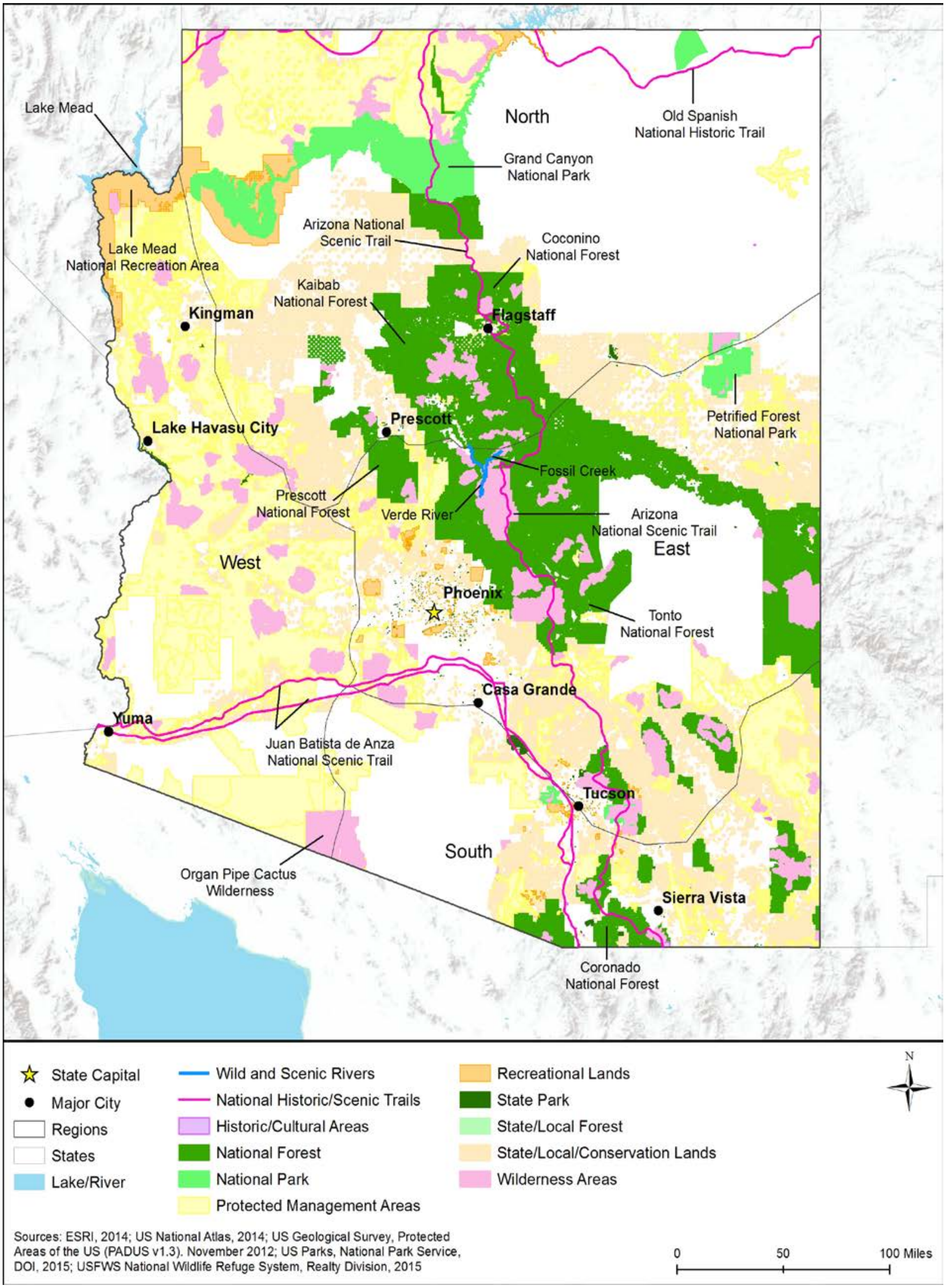

Figure 3.1.7-3: Some Arizona Recreation Resources

West Region[117]

The West Region consists of the western edge of the state along the California border from Nevada in the north to Mexico in the south (see Figure 3.1.7-3).[118] Major recreational features of the Western Region are Lake Mead and the Colorado River.

The Lake Mead National Recreation Area spans the lake, with some facilities in Arizona while others are in Nevada. Recreation within is focused on Lake Mead and Lake Mohave, with swimming, scuba diving, sport fishing, boating, water-skiing, kayaking, and canoeing all popular activities. Other recreational activities include hiking, backcountry hiking, bicycling, horseback riding, and other trail use; camping and picnicking; and seasonal, licensed hunting. (NPS, 2015d)

The Lake Havasu, Cattail Cove, River Island, and Buckskin Mountain State Parks are all along the Colorado River. These parks are visited for recreational activities on the river: swimming, fishing, boating, sailing, canoeing, and kayaking are all popular. Additional recreation includes hiking and trail use; birdwatching and wildlife viewing; and camping and picnicking. (Arizona State Parks, 2015a) (Arizona State Parks, 2015d) (Arizona State Parks, 2015e) (Arizona State Parks, 2015f)

North Region

Arizona's North Region begins in the central part of the state bordering Utah, to the border of New Mexico (Figure 3.1.7-3). The Northern Region is part of the Arizona Plateau, and the Grand Canyon National Park is one of the most visited destinations in the region (AZ Office of Tourism, 2016c).

Grand Canyon National Park is one of the most famous parks in the United States, with over 5 million annual visitors to the South Rim, which includes Grand Canyon Village, Hermit Road, and Desert View Drive (NPS, 2016b). Recreational activities within the park include backcountry hiking, bicycling, mule trips into the canyon, virtual caching,[119] and other trail use and river rafting (NPS, 2016c) (NPS, 2016d).

The Kaibab National Forest consists of prairies, mountain peaks, and plateaus, and has popular locations such as Sycamore Canyon Falls and the Grandview Lookout Tower: recreational activities include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; fishing, boating, and other water activities; downhill skiing, snowboarding, sledding, snowmobiling, and cross-country skiing; target shooting; and seasonal, licensed big game hunting (USFS, 2015a) (USFS, 2016b) (USFS, 2016c). The Prescott National Forest contains

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[117] This document uses regions identified by Arizona State Parks at http://azstateparks.com/find/map.html.

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

[119] Virtual caching is used in lieu of physical geocaching in areas where placement of the traditional physical cache is not allowed (NPS, 2016d).

recreational areas such as the Lynx Lake Recreation Area and the Granite Basin Recreation Area (USFS, 2016d). Activities within the park include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; fishing, boating, tubing, and other water activities; hang gliding; target shooting; and gold panning (USFS, 2016e) (USFS, 2016f) (USFS, 2016g) (USFS, 2016h).

The Coconino National Forest has numerous sites associated with American Indian history, with the Elden Pueblo Archeological Site, Palatki Heritage Site, and V Bar V Heritage Site (USFS, 2016i). Recreational activities within the forest include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; fishing, boating, swimming, windsurfing, waterskiing, and other water activities; downhill skiing, snowboarding, snowmobiling, sledding, cross-country skiing, and other winter activities; and licensed, seasonal big game hunting (USFS, 2016j) (USFS, 2016k) (USFS, 2016l) (USFS, 2016m).

East Region

Arizona's East Region begins in the central part of the state, extending to the state's border with New Mexico (Figure 3.1.7-3). The largest city in the state (see Table 3.1.7-2), Phoenix has museums, botanical gardens, professional sports, and golf courses (AZ Office of Tourism, 2016b).

The Tonto National Forest, with around 5.8 million annual visitors, is nearly 3 million acres of urban forest: activities include hiking, bicycling, horseback riding, and other trail use; camping and picnicking; fishing, boating, swimming, tubing, waterskiing, and other water activities; and licensed, seasonal hunting (USFS, 2015b) (USFS, 2016n) (USFS, 2016o).

The Petrified Forest National Park has backcountry hiking into remote areas: activities within the park include hiking, geocaching, horseback riding, and other trail use; and camping and backpacking (NPS, 2015e) (NPS, 2016e). The Saguaro National Park is the location of the nation's largest cacti. Activities include hiking, camping, and backpacking (NPS, 2015f) (NPS, 2016f).

South Region

Arizona's South Region begins in the central part of the state, bordering Mexico to the south, and extends east to New Mexico (Figure 3.1.7-3) Geographically, it consists of desert and mountain ranges, allowing for diverse recreational opportunities.

The Coronado National Forest, with areas including the Sabino Canyon Recreation Area, the Rose Canyon Lake, and the Gordon Hirabayashi Campground, has recreational activities including: hiking, bicycling, horseback riding, and other trail use; camping and picnicking; lake and pond fishing, boating, and other water activities; and downhill skiing, snowboarding, and other winter activities (USFS, 2015c) (NPS, 2016g) (NPS, 2016h).

There are several state parks in the Southern Region, including the Tombstone Courthouse State Historic Park and the Kartchner Caverns State Park. The Tombstone Courthouse State Historic Park has a visitor's center, a museum, and picnicking facilities (Arizona State Parks, 2015g).

The Kartchner Caverns State Park has a visitor's center with exhibits, camping and picnicking facilities, hiking trails, birdwatching and wildlife viewing, and tours of the cave caverns (Arizona State Parks, 2015h).

3.1.7.5. 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 3.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[120] service is based on the airspace classification (FAA, 2008).

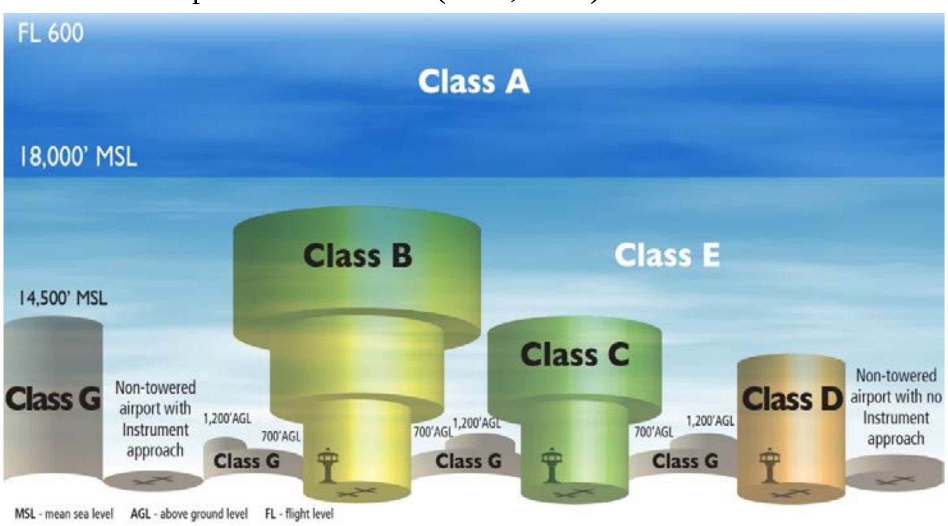

Figure 3.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008)

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

Controlled Airspace

- **Class A:** Airspace from 18,000 to 60,000 feet Mean Sea Level (MSL)[121] including 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).[122]
- **Class B:** Airspace from the surface up to 10,000 feet MSL near the busiest airports with heavy traffic operations. The airspace is tailored to the specific airport in several layers. An ATC clearance is required for all aircraft to operate in this area.
- **Class C:** Airspace from the surface to 4,000 feet above the airport elevation surrounding the airport. Applies to airports with an operational control tower, serviced by a radar approach control, and certain number of IFR operations or total number of passengers boarding aircrafts. Airspace is tailored in layers, but usually extends out to 10 NM from 1,200 feet to 4,000 feet above the airport elevation. Entering Class C airspace requires radio contact with the controlling ATC authority, and an ATC clearance is ultimately required for landing.
- **Class D:** Airspace from the surface to 2,500 feet above the airport elevation surrounding airports with an operational control tower. Airspace area is tailored. Aircraft entering the airspace must establish and maintain radio contact with the controlling ATC.
- **Class E:** Controlled airspace not designated as Class A, B, C, or D. Class E airspace extends upward from the surface or a designated altitude to the overlying or adjacent controlled airspace (FAA, 2008).

Uncontrolled Airspace

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

Special Use Airspace (SUA)

SUA designates airspace that imposes limitations on aircraft activities (Table 3.1.7-5).

Table 3.1.7-5: SUA Designations

SUA	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."

[121] 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).
[122] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).

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

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

Other Airspace Areas

Other airspace areas, explained in Table 3.1.7-6, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 3.1.7-6: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute miles (5,280 feet/mile) 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

Type	Definition
	• Protect in the State of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of "permanent" are included in this Draft PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

3.1.7.6. Aerial System Considerations

Unmanned Aerial Systems

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

UAS at airports is a complex operational challenge with the need to separate UAS flight operations from mainstream air traffic. Separation can be achieved with specific UAS launch windows, special airports, or off-airport locations that allow the UAS to easily launch and recover. Special aviation procedures are applied to UAS flights. There must be the capability of Sense and Avoid (SAA) and Control and Communication (C2) during UAS operations. An Unmanned Aircraft (UA) must be able to see (or sense) other aircraft in the area and avoid the aircraft through corrected flight path changes. General equipment and operational requirements can include aircraft anti-collision lights, an altitude encoding transponder, cameras, sensors, and collision avoidance maneuvers. The C2 of the UA occurs with the pilot/operator, the UAS control station, and ATC. Research efforts, a component of the FAA's UAS roadmap, continue to mature the technology for both SAA and C2 capabilities.

Balloons

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

3.1.7.7. Obstructions to Airspace Considerations

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

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

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

3.1.7.8. Arizona Airspace

The Arizona Aeronautics Group is a component of The Arizona Department of Transportation (AZDOT). The primary focus of AZDOT and the Aeronautics Group is management and development of the state's airport system (e.g., planning, safety, efficiencies, usage demands, accessibility, and environmental protection). Responsibilities include funding, environmental assessments, airfield inspections, and engineering. (AZDOT, 2015b) There is one FAA FSDO for Arizona located in Scottsdale (FAA, 2015e).

Arizona airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the State's airport system, as well as addressing key associated with their airports. (National Association of State Aviation Officials, 2015) Figure 3.1.7-5 presents the different aviation airports/facilities residing in Arizona, while Figures 3.1.7-6 and 3.1.7-7 present the breakout by public and private airports/facilities. There are approximately 308 airports within Arizona as presented in Table 3.1.7-7 and Figures 3.1.7-5 through 3.1.7-7 (USDOT, 2015a).

Table 3.1.7-7: Type and Number of Arizona Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	78	111
Heliport	0	110
Seaplane	0	0
Ultralight	0	6
Balloonport	0	0
Gliderport	1	2
Total	**79**	**229**

Source: (USDOT, 2015a)

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

- One Class B –
  - Phoenix Sky Harbor International, Phoenix
- Two Class C –
  - Davis-Mothan Air Force Base (AFB), Tucson
  - Tucson International
- Seventeen Class D –
  - Laughlin/Bullhead International, Bullhead City
  - Williams Gateway, Chandler
  - Chandler Municipal, Chandler
  - Flagstaff Pulliam, Flagstaff
  - Sierra Vista Municipal Airport-Libby Army Airfield, Fort Huachuca
  - Gila Bend Air Force Auxiliary Field
  - Glendale Municipal
  - Grand Canyon National Park
  - Laguna Army Airfield (AFF) (Yuma Proving Ground), Yuma
  - Falcon Field, Mesa
  - Deer Valley Municipal, Phoenix
  - Luke AFB, Phoenix
  - Phoenix-Goodyear Municipal, Goodyear
  - Ernest A. Love Field, Prescott
  - Scottsdale Municipal, Scottsdale
  - Ryan Field, Tucson
  - Yuma Marine Corps Air Station-Yuma International, Yuma (FAA, 2016)

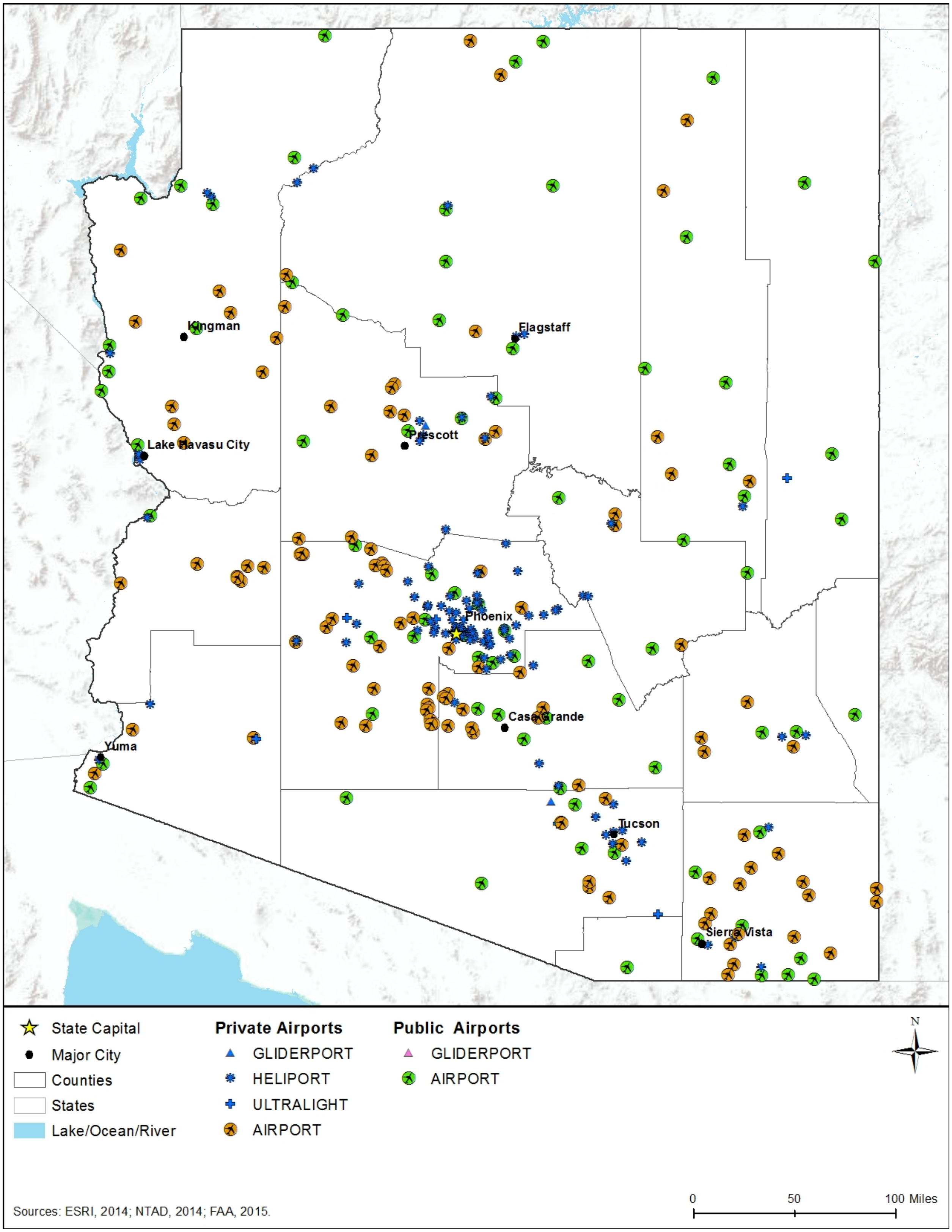

Figure 3.1.7-5: Public and Private Airports/Facilities in Arizona

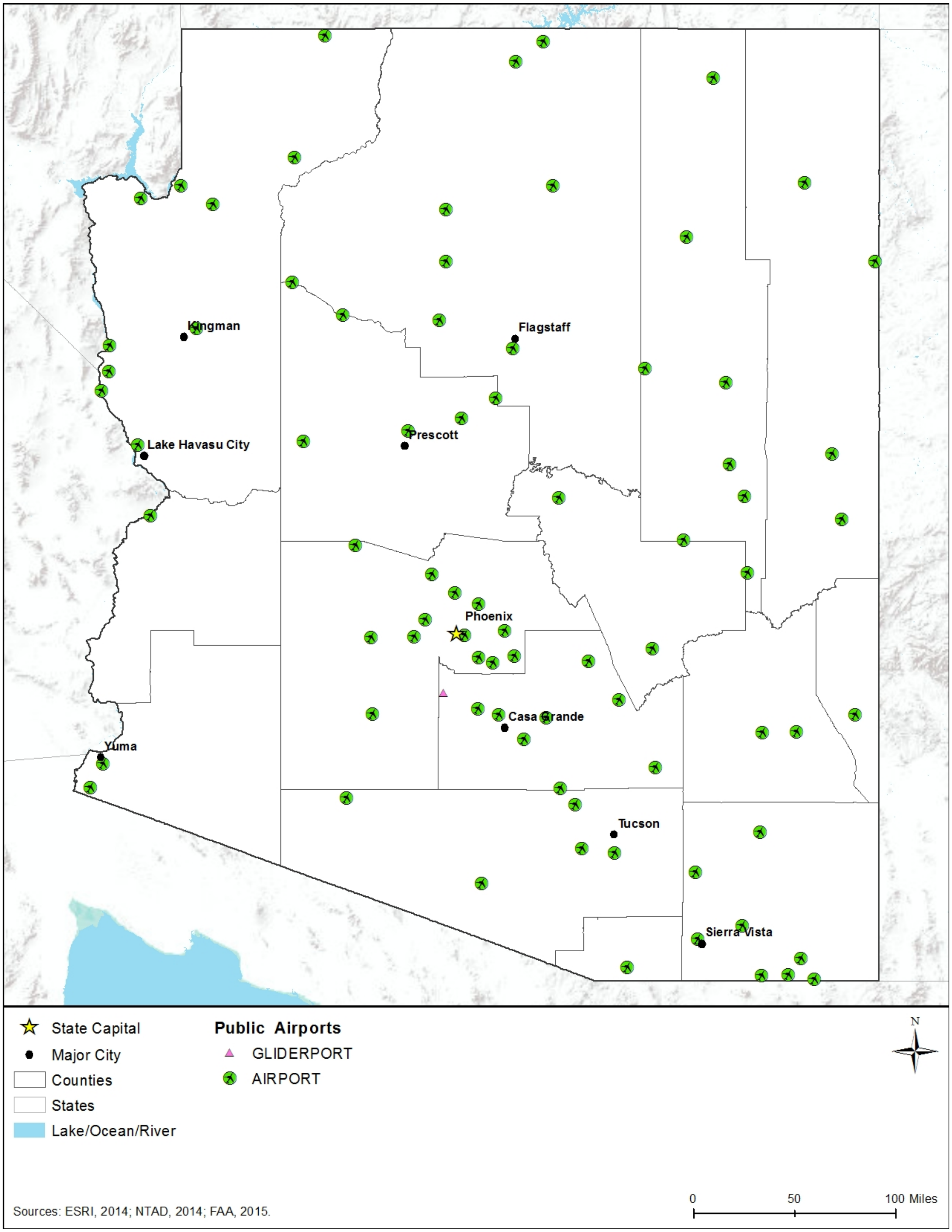

Figure 3.1.7-6: Public Arizona Airports/Facilities

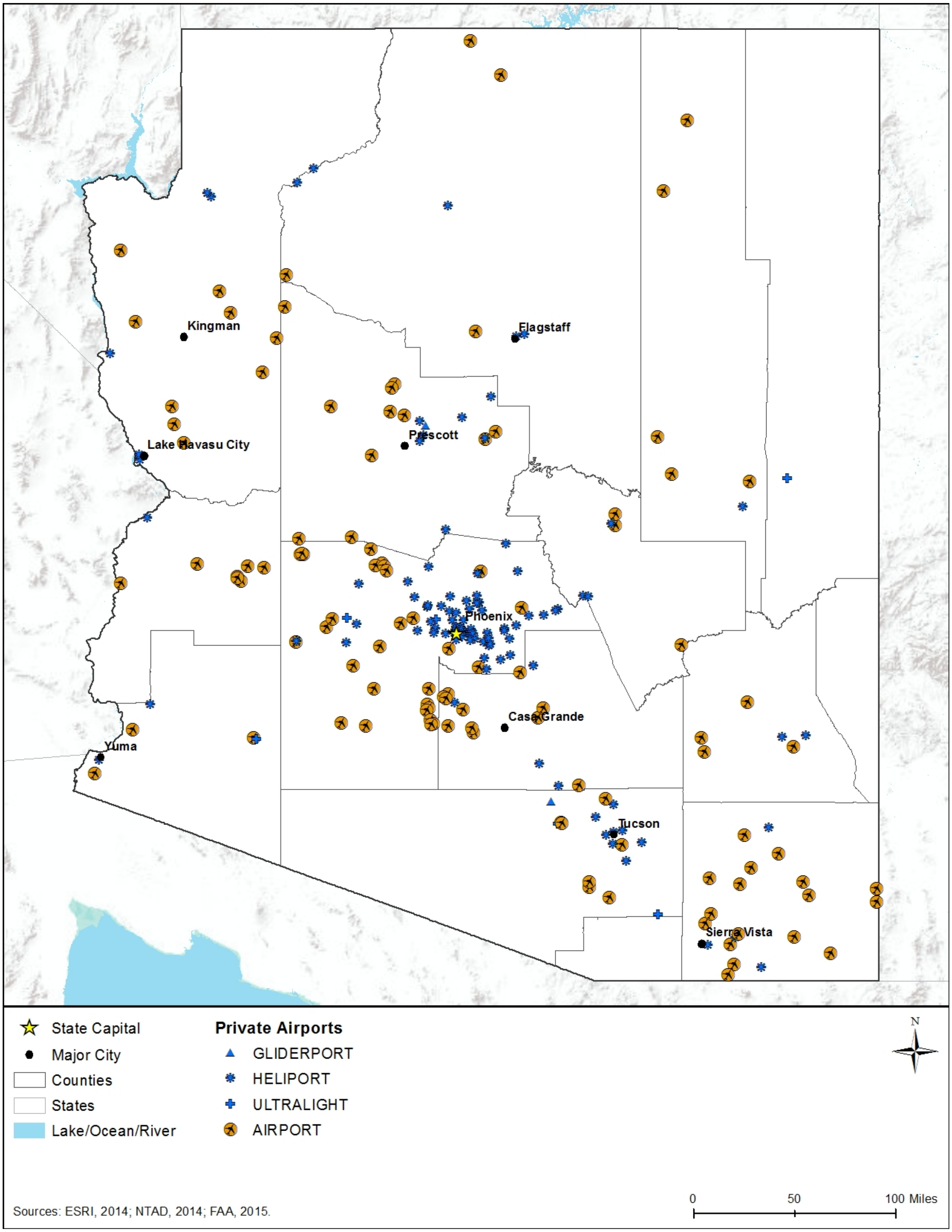

Figure 3.1.7-7: Private Arizona Airports/Facilities

SUAs (i.e., 23 restricted areas, eighteen MOAs, and one alert area) located in Arizona are as follows:

- Ajo (Restricted) –
  - R-2301E – Surface to FL 800
  - R-2301W – Surface to FL 800
- Flagstaff (Restricted) –
  - R-2302 – Surface to 10,000 feet MSL
- Fort Huachuca (Restricted) –
  - R-2303A – Surface to 15,000 feet MSL; Excluding the airspace from the surface to 7,000 feet MSL within a three NM radius of the Fort Huachuca/Libby AAF/Sierra Vista Municipal Airport, AZ; and Excluding the airspace from the surface to 7,000 feet MSL within one NM either side of U. S. Highway 90
  - R-2303B – 8,000 feet MSL to FL 300; Excluding that airspace within R-2303A when activated
  - R-2303C – 15,000 feet MSL to FL 300
  - R-2312 – Surface to but not including 15,000 feet MSL
- Gila Bend (Restricted) –
  - R-2304 – Surface to FL 240
  - R-2305 – Surface to FL 240
- Yuma (Restricted) –
  - R-2306A – Surface to 80,000 feet MSL
  - R-2306B – Surface to 80,000 feet MSL
  - R-2306C – Surface to 40,000 feet MSL
  - R-2306D – Surface to FL 230
  - R-2306E – Surface to 80,000 feet MSL
  - R-2307 – Unlimited
  - R-2308A – 1,500 feet AGL to 80,000 feet MSL
  - R-2308B – Surface to 80,000 feet MSL
  - R-2308C – 1,500 feet AGL to FL 230
  - R-2309 – Surface to 15,000 feet MSL
  - R-2311 – Surface to 3,500 feet MSL
- Florence (Restricted) –
  - R-2310A – Surface to 10,000 feet MSL
  - R-2310B – 10,000 feet MSL to 17,000 feet MSL
  - R-2310C – 17,000 feet MSL to 35,000 feet MSL (FAA, 2015g)

The eighteen MOAs for Arizona are as follows:

- Bagdad 1 – 7,000 feet MSL or 5,000 feet AGL (whichever is higher) to, but not including, FL 180
- Dome – 6,000 feet MSL to, but not including, FL 180
- Fuzzy – 100 feet AGL up to, but not including, 10,000 feet MSL
- Gladden – 7,000 feet MSL or 5,000 feet AGL (whichever is higher) to, but not including, FL 180

- Jackal –
  - Jackal – 11,000 feet MSL or 3,000 feet AGL (whichever is higher) to, but not including, FL 180
  - Jackal Low – 100 feet AGL to, but not including, 11,000 feet MSL or 3,000 feet AGL (whichever is higher); Excluding the airspace from the surface to 1,500 feet AGL within a three NM radius of the Flying J Ranch Airport (lat. 32°50'52" N., long. 109°52'54" W.)
- Morenci – From 1,500 feet AGL to, but not including, FL 180
- Outlaw – 8,000 feet MSL or 3,000 feet AGL (whichever is higher) to, but not including, FL 180; Excluding Restricted Areas R-2310A, B, and C when activated
- Quail – 10,000 feet MSL to, but not including, FL 180
- Reserve – 5,000 feet AGL to, but not including, FL 180
- Ruby 1 – 10,000 feet MSL to, but not including, FL 180
- Sells –
  - 1 – 10,000 feet MSL to, but not including, FL 180
  - Low – From 3,000 AGL up to, but not including, 10,000 MSL
- Sunny – 12,000 feet MSL up to, but not including, FL 180
- Tombstone –
  - A – 500 feet AGL to, but not including, 14,500 feet MSL
  - B – 500 feet AGL to, but not including, 14,500 feet MSL
  - C – 14,500 feet MSL to, but not including, FL 180
- Turtle – 11,000 feet MSL to, but not including, FL 180 (FAA, 2015g)

The one alert area for Arizona is:

- Luke AFB –
  - A-231 – From 500 feet AGL to and including 6,500 feet MSL; Excluding the airspace below 4,000 feet AGL within the Phoenix Luke AFB, AZ, Class D airspace area (FAA, 2015g)

The SUAs for Arizona are presented in Figure 3.1.7-8. There are no TFRs (See Figure 3.1.7-8) (FAA, 2015h). MTRs in Arizona, presented in Figure 3.1.7-9, consist of 20 Visual Routes, 11 Instrument Routes, and 2 Slow Routes (ESRI, 2014, DAFIF, June, 2015).

UAS Considerations

The National Park Service (NPS) signed a policy memorandum on June 24, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service" (NPS, 2014b). There are 22 NPS units within Arizona that has to comply with this agency directive (NPS, 2015g).

Obstructions to Airspace Considerations

Several references in Arizona statutes address airspace hazards. As defined by the Arizona Revised Statute, Chapter 25 Aviation, Article 7 Airport Zoning and Regulation, 28-8461 Definitions, an airport hazard "…means an area of land or water that is designed and set aside for the landing and taking off of aircraft and that is utilized or to be utilized in the interest of the public for those purposes" (Arizona State Legislature, 2015a). The same statute (28-8470) regulates structures as it pertains to potential impacts to navigable airspace. A permit is required for any replacement, change, or repair to a non-conforming structure or replacement of a tree. Permits will not be issued when a non-conforming structure or tree is higher or a greater hazard to air navigation; or when an airport hazard is created as a result of changes to structures or replacement of trees (Arizona State Legislature, 2015b).

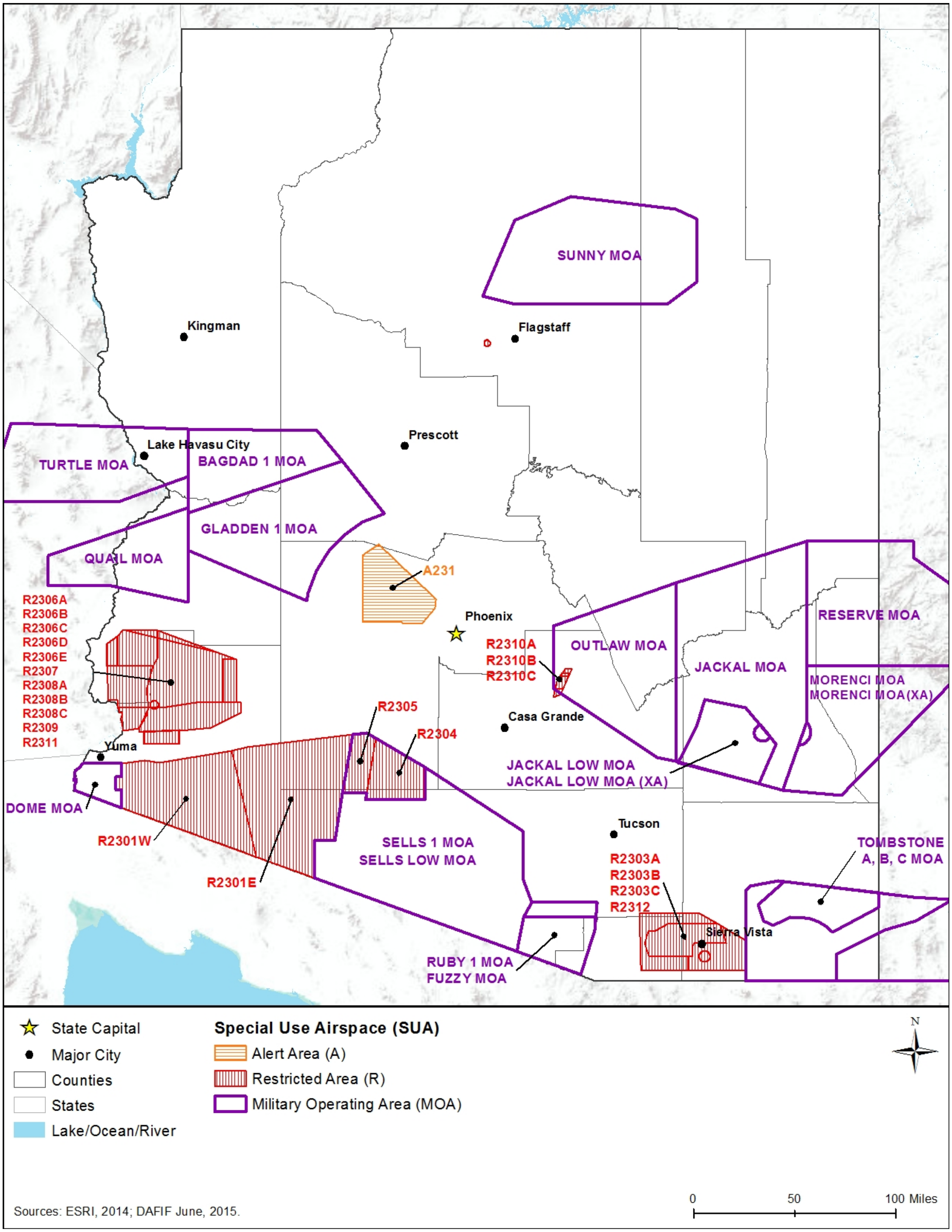

Figure 3.1.7-8: SUAs in Arizona

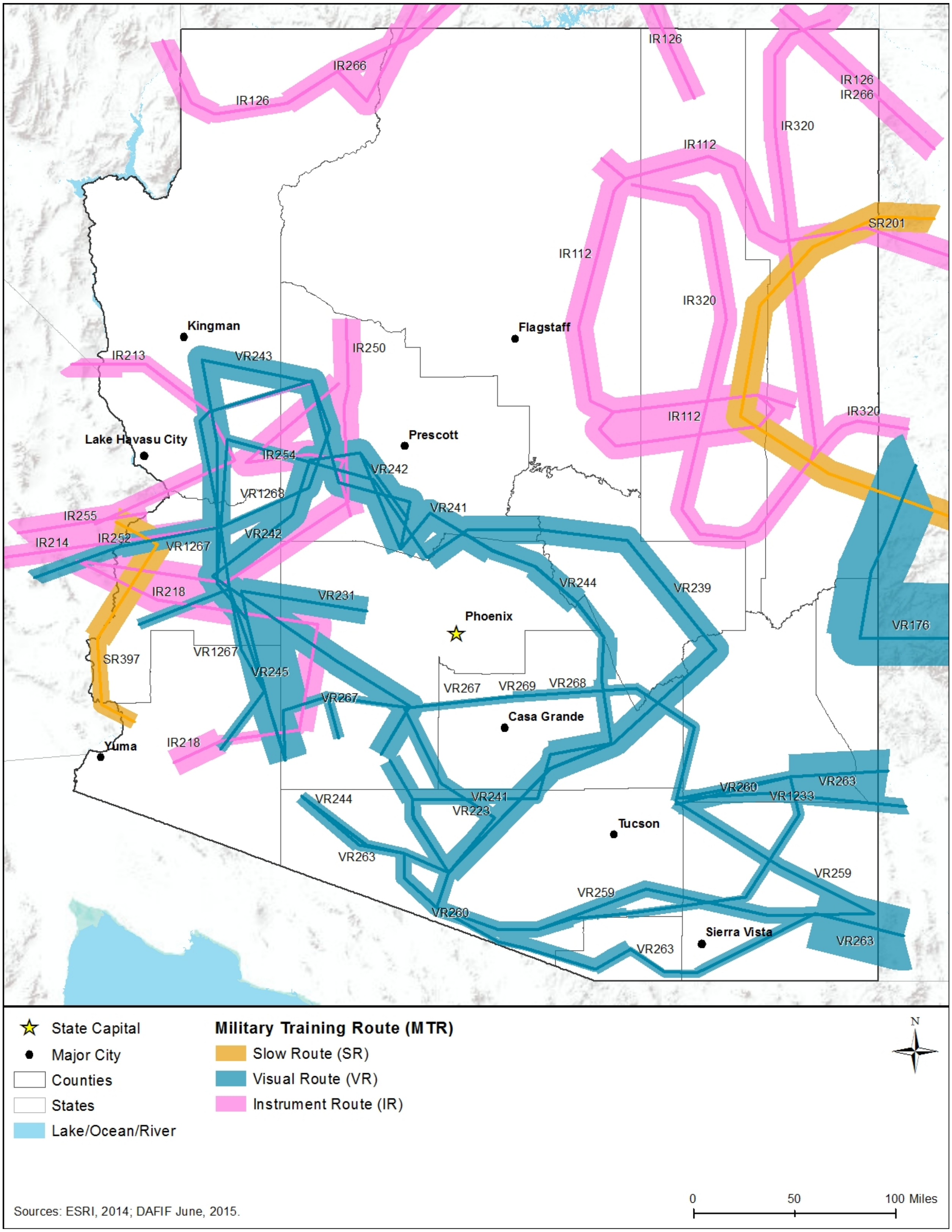

Figure 3.1.7-9: MTRs in Arizona

3.1.8. Visual Resources

3.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features such as mountain ranges, city skylines, ocean views, unique geological formations, rivers, and constructed landmarks such as bridges, memorials, cultural resources, or statues are considered visual resources. For some, cityscapes are valued visual resources; for others, views of natural areas are valued visual resources. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for NEPA and National Historic Preservation Act (NHPA) compliance. The federal government does not have a 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, 1984)

3.1.8.2. Specific Regulatory Consideration

Table 3.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 3.1.8-1: Relevant Visual Resources Laws and Regulations

State Law/Regulation	Agency	Applicability
State Historic Preservation Act (SHPA), A.R.S. § 41-861 et seq.	State Historic Preservation Office (SHPO)	Establishes the historical advisory commission to preserve historic and cultural resources in the state.
A.R.S § 37 Chapter 6, Natural Resource Conservation Districts	State Land Commissioner	Delegates authority to state Natural Resource Conservation Districts for research, governmental agreements, property acquisition, and educational activities for the benefit of enhanced natural resources to support scenic beauty.
A.R.S. § 41-512 et seq., Establishment of Parkways and Historical and Scenic Roadways	AZDOT	Establishes Advisory Committee to determine parkway, historic or scenic roads.
A.R.S. § 41-511 et seq., Arizona State Parks Board	Arizona State Parks	Establishes the Arizona State Parks Board to maintain and preserve natural features, scenic beauty, historical and scientific interest, and zoos and botanical gardens, for the education, pleasure, recreation, and health of the people and to maintain a state historic preservation program including a state register of historic places and identifies responsibilities for the SHPO.
A.R.S. § 17-231	AZGFD	Establishes the Game and Fish Department to develop program and policies for the management, preservation, and harvest of wildlife including establishment of game units and preserves for wildlife.

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

3.1.8.3. Character and Visual Quality of the Existing Landscape

Arizona has a variety of contrasting visual resources. The state is home to landscape such as the Colorado Plateau, flat lands, mountains, valleys, gorges, boulders, shrubs, Black Mesa, Painted Desert, Rocky Mountains, rivers, and forested mountain ranges (World Atlas, 2015). Arizona is also home to the Grand Canyon, a more than five million year old 190-mile long chasm carved by the Colorado River (NPS, 2016b). About 42 percent of Arizona consists of public lands managed by the Bureau of Land Management (BLM), U.S. Forest Service (USFS), Department of Defense (DoD), National Park Service (NPS), U.S. Fish and Wildlife Service (USFWS), and Bureau of Reclamation (see Table 3.1.7-3 and Figure 3.1.7-2, Land Use, Recreation, and Airspace) (USGS, 2014f). Almost half the state contains significant scenic resources, and due to the large amount of public lands, much of those resources are protected through the policies of the respective land management agencies and state and federal regulations (see Table 3.1.8-1) to help minimize loss or damage of the resource.

More than half of Arizona is characterized as desert (Figure 3.1.7-1 in Section 3.1.7, Land Use, Recreation, and Airspace). Mountains, such as the Superstition Mountains, are forested with notable species including ponderosa, Chihuahuan and Apache pine and Douglas fir. Vegetation in the foothills are mixed grass, chaparral brush, and juniper. (USFS, 2016p) Arizona is also rich is cultural sites with ruins, cliff dwellings, and historic buildings (NPS, 2015c).

One aspect of importance for visual resources is to maintain the landscape character, the arrangement formed by the “variety and intensity of the landscape features” of “form, line, color, and texture” (BLM, 1984). For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos might 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 may be important to maintain if new development were to occur. Section 3.1.7 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.

3.1.8.4. 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. “Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape” (NYS DEC, 2015).

Figure 3.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Arizona, there are 1,419 NRHP listed sites, which include 45 National Historic Landmarks, one World Heritage Site, two National Historic Sites, one National Heritage Area, and one National Historical Park (NPS, 2015c). Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

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

World Heritage Site

Sites are designated World Heritage sites if they reflect "the world's cultural and natural diversity of outstanding universal value" (UNESCO, 2015a). To be included on the World Heritage List, sites must meet 1 of 10 criteria reflecting cultural, natural, or artistic significance (UNESCO, 2015b). World Heritage sites are diverse and range from archaeological remains, national parks, islands, buildings, city centers, and cities. The importance of World Heritage-designated properties can be attributed to cultural or natural qualities that may be considered visual resources or are visually sensitive at these sites. In Arizona, there is one World Heritage site, the Grand Canyon National Park, whose visual resources include an almost mile-deep gorge that started forming six million years ago (see Figure 3.1.8-3) (UNESCO, 2015c).

National Heritage Areas

National Heritage Areas (NHAs) are "places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape" (NPS, 2016i). These areas help tell the history of the United States. Based on this criteria, NHAs in Arizona may contain scenic or aesthetic areas considered visual resources or visually sensitive. There is one NHA in Arizona, the Yuma Crossing National Heritage Area (Figure 3.1.8-1). Yuma Crossing NHA encompasses the crossing of the Colorado River at Yuma, Arizona and is currently undergoing restoration of the region's wetlands habitat (NPS, 2015h).

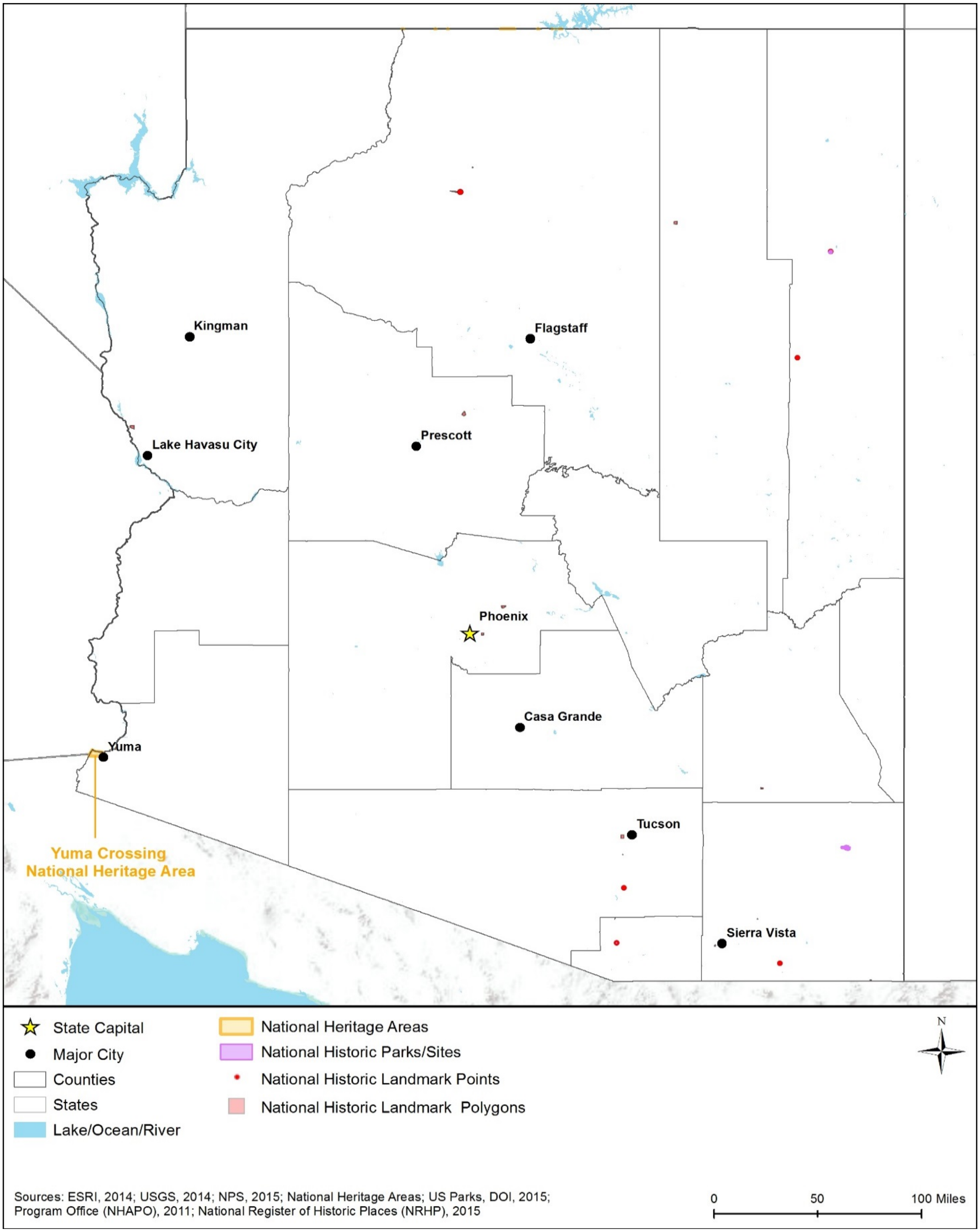

Figure 3.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

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, 2016j). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Arizona, there are 45 NHLs, including sites such as the Double Adobe Site, Fort Huachuca, Grand Canyon Village, Pueblo Grande Ruin and Irrigation Sites, and Taliesin West (Figure 3.1.8-1) (NPS, 2015j). By comparison, there are over 2,500 NHLs in the United States, with less than 2 percent of these located in Arizona (NPS, 2015k). Figure 3.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Historic Sites and Historical Parks

Arizona has two National Historic Sites and one National Historical Park, which are preserved by the NPS to "commemorate persons, events, and activities important in the nation's history" (NPS, 2003) (NPS, 2015c). Parks are generally larger in size and complexity than sites (NPS, 2003). The two national historic sites in Arizona include Fort Bowie and Hubbell Trading Post. The National Historical Park is Tumacácori (NPS, 2015c). These sites and parks may contain aesthetic and scenic values associated with history. Locations of the above are identified on the map in Figure 3.1.8-1 (NPS, 2015c).

State Historic Sites and Parks

Arizona's State Historic Preservation Office, a division of Arizona State Parks, assists private entities, local, state and tribal governments, and federal agencies with "identification, evaluation, protection, and enhancement of historic and archaeological properties that have significance for local communities, the state, or the Nation" for the state and/or national registers of historic places (Arizona State Parks, 2015i). Arizona State Parks directly manage 10 historic parks and associated visual resources as part of their mission to "[manage] and [conserve] Arizona's natural, cultural, and recreational resources for the benefit of the people" (Arizona State Parks, 2015j). These parks are:

- Tombstone Courthouse State Historic Park,
- McFarland State Historic Park,
- Yuma Territorial Prison State Historic Park,
- Tubac Presidio State Historic Park,
- Fort Verde State Historic Park,
- Jerome State Historic Park,
- Riordan Mansion State Historic Park,
- Oracle State Park,
- Yuma Quartermaster Depot State Historic Park, and
- Homolovi State Park (Arizona State Parks, 2015k).

Riordan Mansion State Historic Park includes a 13,000 square foot Arts and Crafts style home, Riordan family artifacts, furniture and mementos, as well as beautifully landscaped grounds (Arizona State Parks, 2015l).

3.1.8.5. Parks and Recreation Areas

Parks and recreation areas include State Parks, State Forests, National Parks, National Recreation Areas, National Forests, National Monuments, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 3.1.7-3 in Section 3.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources in Arizona. Figure 3.1.8-3 displays natural areas that may be visually sensitive, including park and recreation areas.[123]

National Park Service

National Parks are managed by the National Park Service (NPS), and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Arizona, there are 22[124] officially designated national parks units in addition to other affiliated areas, such as National Heritage Areas. There are 3 National Parks, 2 National Historic Trails, 14 National Monuments, and 2 National Recreation Areas (Figure 3.1.8-2 shows an image of Lake Mead National Recreation Area) (NPS, 2015c). Table 3.1.8-2 identifies the National Parks and affiliated areas located in Arizona. For additional information regarding parks and recreation areas, see Section 3.1.7, Land Use, Recreation, and Airspace.

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

[124] This count is based on the NPS website "by the numbers" current as of September 30, 2014 (NPS, 2015p). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

Figure 3.1.8-2: Lake Mead National Recreation Area

Source: (NPS, 2015l)

Table 3.1.8-2: Arizona National Parks and Affiliated Areas

Area Name	
Canyon de Chelly National Monument	Old Spanish National Historic Trail[125]
Casa Grande Ruins National Monument	Organ Pipe Cactus National Monument
Chiricahua National Monument	Grand Canyon-Parashant National Monument[126]
Coronado National Memorial	Petrified Forest National Park
Fort Bowie National Historic Site	Pipe Spring National Monument
Glen Canyon National Recreation Area	Saguaro National Park
Grand Canyon National Park	Sunset Crater Volcano National Monument
Hohokam Pima National Monument	Tonto National Monument
Hubbell Trading Post National Historic Site	Tumacácori National Historical Park
Juan Bautista de Anza National Historic Trail	Tuzigoot National Monument
Lake Mead National Recreation Area	Walnut Canyon National Monument
Montezuma Castle National Monument	Wupatki National Monument
Navajo National Monument	Yuma Crossing National Heritage Area[127]

Source: (NPS, 2015c)

[125] NPS and BLM jointly manage the Old Spanish National Historic Trail (BLM, 2015g). It is included in Table 3.1.8-2 and Table 3.1.8-3 to show the most accurate count.

[126] NPS and BLM jointly manage the Grand Canyon-Parashant National Monument (BLM, 2015h). It is included in Table 3.1.8-2 and Table 3.1.8-3 to show the most accurate count.

[127] The Yuma Crossing National Heritage Area is manged by the Yuma Crossing National Heritage Area Corporation, a local, citizen-led non-profit (NPS, 2016n).

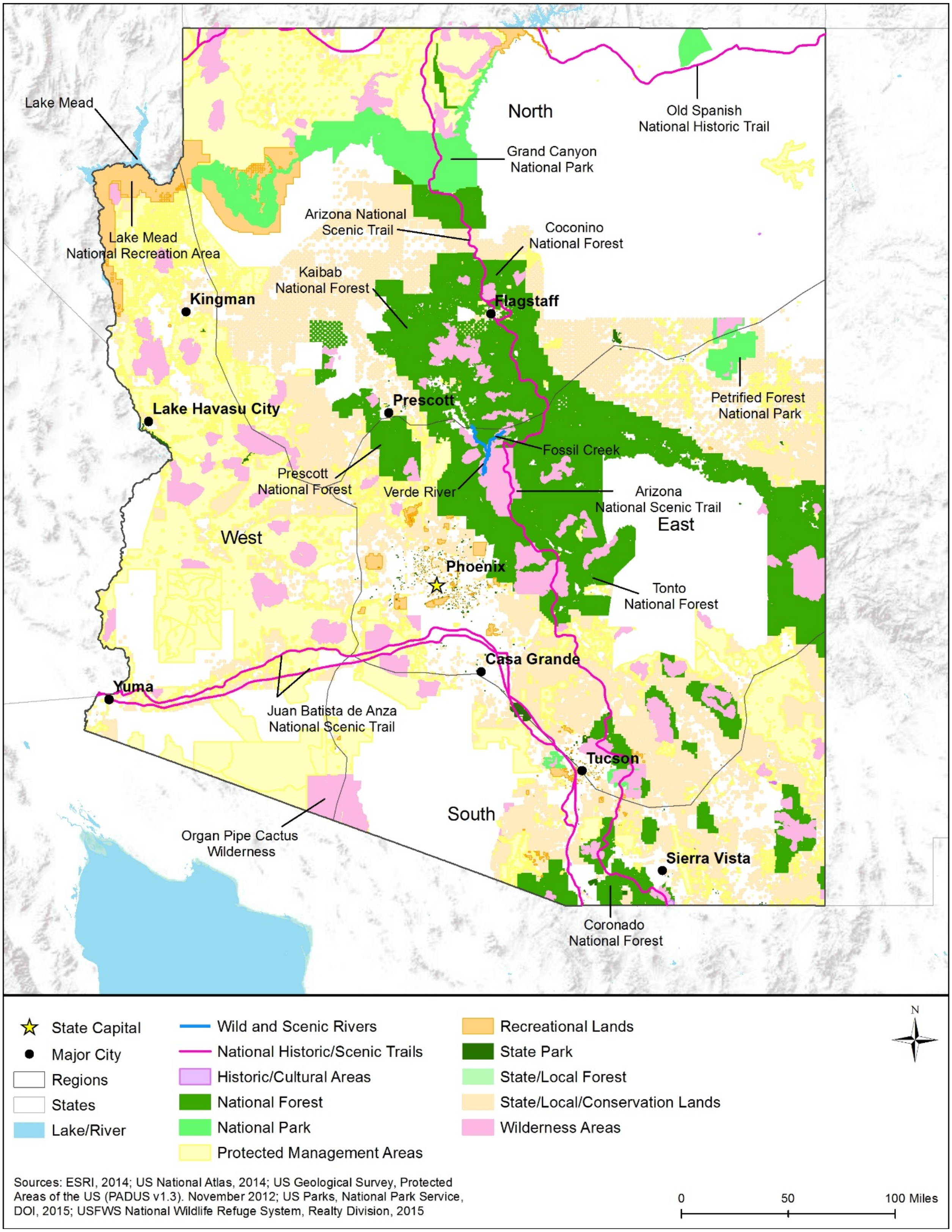

Figure 3.1.8-3: Natural Areas that May be Visually Sensitive

Bureau of Land Management (BLM) Areas

The BLM manages 19,331 square miles of land in Arizona (USGS, 2014f). These lands are managed under a multiple use mandate meaning that BLM must allow many uses of the lands, from recreation, to livestock grazing, forestry, wildlife habitat, and energy development (NPS, 2012). The BLM uses their visual resources management system to "identify and evaluate scenic values to determine the appropriate levels of management." Lands that are classified with high scenic values are assigned management that prevents or reduces impacts to the visual resources, protecting the scenic landscape (BLM, 2012). BLM lands with high scenic values are less likely to be developed or have the visual resources disturbed. Management varies among uses and resources, some areas, like lands adjacent to wild and scenic rivers, will be managed for high quality visual resources. Other areas, such as where energy development is occurring, may be managed for lower quality visual resources (BLM, 1986). Table 3.1.8-3 identifies the BLM units located in Arizona.

Table 3.1.8-3: Arizona BLM Service Areas

Area Name	
Agua Fria National Monument	Las Cienegas National Conservation Area
Grand Canyon-Parashant National Monument[128]	San Pedro Riparian National Conservation Area
Ironwood National Monument	Old Spanish National Historic Trail[129]
Sonoran Desert National Monument	Arizona National Scenic Trail
Vermilion Cliffs National Monument	Baker Canyon Wilderness Study Area
Gila Box Riparian National Conservation Area	Wilderness Areas (See Table 3.1.8-9)
Cactus Plain Wilderness Study Area	

Source: (BLM, 2015e).

National Monuments

The NPS defines a national monument as a "nationally significant resource…smaller than a national park and [lacking]…diversity of attractions." Arizona is home to 14 national monuments managed by NPS including Canyon De Chelly, Casa Grande Ruins, Chiricahua, Hohokam Pima, Grand Canyon-Parashant, [130] Montezuma Castle, Navajo, Organ Pipe Cactus, Pipe Spring, Sunset Crater Volcano, Tonto, Tuzigoot, Walnut Canyon, and Wupatki (see Table 3.1.8-2 and Figure 3.1.8-3) (NPS, 2015c). Additionally, the BLM designates national monuments to "afford protection, conservation, and restoration to landscapes of tremendous beauty, diversity, and historic or scientific interest" (BLM, 2015i). There are five national monuments administered by BLM in Arizona: Agua Fria, Grand Canyon-Parashant, [131]

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[128] NPS and BLM jointly manage the Grand Canyon-Parashant National Monument (BLM, 2015h). It is included on both lists for consistency.

[129] NPS and BLM jointly manage the Old Spanish National Historic Trail (BLM, 2015g). It is included in Table 3.1.8-2 and Table 3.1.8-3 to show the most accurate count.

[130] NPS and BLM jointly manage the Grand Canyon-Parashant National Monument (BLM, 2015h). It is included on both lists for consistency.

[131] NPS and BLM jointly manage the Grand Canyon-Parashant National Monument (BLM, 2015h). It is included on both lists for consistency.

Ironwood, Sonoran Desert, and Vermilion Cliffs (see Figure 3.1.8-3 and Table 3.1.8-3) (BLM, 2015e).

National Forests

The U.S. Department of Agriculture manages six national forests in Arizona (see Figure 3.1.8-3): Apache-Sitgreaves, Coconino, Coronado, Kaibab, Prescott, and Tonto (USFS, 2013). The U.S. Forest Service conducts inventories of the forestlands and assigns scenic resource categories from which they manage for scenic and visual resources (USDA, USFS, 1995). These scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USDA, USFS, 1995). Table 3.1.8-4 lists the national forests in Arizona and their visual resources.

Table 3.1.8-4: National Forests in Arizona

National Forest Name	Acres	Visual Resources
Apache-Sitgreaves National Forest	200,000	Mountain vistas, clear streams, canyons, lush vegetation, Blue River, rugged mountains, pine, fir and spruce stands, wildlife, wildflowers
Coconino National Forest	1.8M	Pine-covered plateau, deep canyons, Mogollon Rim, San Francisco Peaks, Red Rocks, Verde River, Lake vistas
Coronado National Forest	1.7M	Scattered mountain ranges (“sky islands”), giant saguaros, wildflowers, cottonwood trees, wildlife, rocky outcroppings, stony hoodoos, grasslands, oak woodlands
Kaibab National Forest	1.6M	High country, Grand Canyon views, wildlife, ponderosa pine forest, volcanic hills and mountains, lakes
Prescott National Forest	1.25M	Verde River, Bradshaw and Santa Maria mountains, manmade lakes, pine stands
Tonto National Forest	3M	Cactus-covered desert, pine-forested mountains, lake beaches, streams, wooded lakes, reservoirs

Sources: (State Parks.com, 2015) (USFS, 2013) (USDA, 2014)

U.S. Army Corps of Engineers Recreation Areas

There are two U.S. Army Corps of Engineers (USACE) recreation and flood risk management areas within the state: Alamo Lake and Painted Rock Dam (see Figure 3.1.8-3) (USACE, 2015). 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).

Bureau of Reclamation

The Bureau of Reclamation’s “multipurpose approach to water resource development” includes offering recreation areas with important natural and cultural resources (BOR, 2015). When planning for recreation, the Bureau must ensure that “potential impacts to natural and cultural resources…are taken into consideration” (BOR, 2009). Visual resources in these natural areas may revolve around water sources such as lakes, canals, and reservoirs. Table 3.1.8-5 lists the 15 Bureau of Reclamation recreation areas in Arizona (see Figure 3.1.8-3) (BOR, 2015).

Table 3.1.8-5: Arizona Bureau of Reclamation Recreation Areas

Apache Lake	Saguaro Lake State Park
Arizona Horse Lovers Park	Salt River Project Canals
Bartlett Reservoir	Sanctuary Golf Course
Canyon Lake	Scottsdale Sports Complex
Davis Dam Camp	Theodore Roosevelt Lake
Horseshoe Reservoir	The Players Championship (TPC) Stadium and Champions Golf Courses
Lake Pleasant Regional Park	WestWorld
Reach 11 Sports Complex	

Source: (BOR, 2015)

Federal and State Trails

Designated under Section 3 of the National Trails System Act (16 USC 1241-1251, as amended), National Scenic Trails (NSTs) are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass" (NPS, 2012). There is one NST in Arizona, the Arizona Trail (Figure 3.1.8-3). The Arizona Trail consists of 820 miles stretching from the international border of Mexico to Utah that highlights the "topographic, biologic, historic, and cultural diversity" of the state, 45 miles of which is managed by BLM (BLM, 2015d).

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, 2012). Two National Historic Trails pass through Arizona and surrounding states (Figure 3.1.8-1): Juan Bautista de Anza National Historic Trail and the Old Spanish National Historic Trail. The Juan Bautista de Anza National Historic Trail is 1,200 miles of history, culture, and recreation recounting the establishment of the "first non-native settlement at San Francisco Bay" by Juan Bautista de Anza and his followers. The Old Spanish National Historic Trail follows the "routes of mule pack trains from Santa Fe, New Mexico to Los Angeles, California" where horses and mules were exchanged for merchandise across 6 states for more than 400 miles (NPS, 2014c) (Old Spanish Trail Association, 2015).

In addition to National Scenic and National Historic Trails, the National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015). In Arizona, there are 35 National Recreation Trails administered by the BLM, NPS, USFS, USFWS, and local or state governments (National Recreation Trails, 2015).

Arizona's State Trails System offers a "diversity of quality [non-motorized] trails that inspire people to experience the State's magnificent outdoor environment and cultural history." The system includes more than 600 trails and thousands of miles that offer recreational opportunities to residents and visitors (Arizona State Parks, 2015m). These trails have aesthetic resources such as desert scenery, pine forests, an extinct volcano, wildflowers, streams, and meadows (Arizona

State Parks, 2015n). For additional information about Arizona's trails, visit the 'State Trails System' on the Arizona State Parks website (Arizona State Parks, 2015m).

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Arizona residents and visitors. Arizona State Parks protect and preserve 19 State Parks, eight Historic Parks, three Natural Areas, and one State Recreation Area (Figure 3.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Arizona State Parks, 2015j). Table 3.1.8-6 contains a sampling of state parks and their associated visual attributes. For example, the Homolovi State Park contains a variety of Indian artifacts and pueblo, archaeological sites, and scenic views (Figure 3.1.8-4). For a complete list of state parks, visit the Arizona State Parks website (Arizona State Parks, 2015j).

Table 3.1.8-6: Examples of Arizona State Parks and Associated Visual Attributes

State Park	Visual Attributes
Buckskin Mountain State Park	Mountain vistas, river views, wildlife, desert landscape
Homolovi State Park	Archaeological sites, Indian artifacts, pueblo, stone landscape, flood plain, sandy slopes, pioneer cemetery
Kartchner Caverns State Park	Limestone cave, calcite formations – longest soda straw stalactite in the world, most extensive brushite moonmilk in the world, hummingbird garden, desert landscape
Slide Rock State Park	Natural water slide, red sandstone, canyon, slippery creek bottom, rustic cabins, homestead, desert landscape
Tonto Natural Bridge State Park	Pine tree forest, natural travertine bridge, valley, caves, green valley, mountain views

Source: (Arizona State Parks, 2015c)

Figure 3.1.8-4: Homolovi State Park

Source: (Homolovi State Park, 2015)

State Forests

Arizona landscape is approximately 27 percent forested, located mostly above the Mogollon Rim and distinct areas throughout the state (Arizona State Forestry, 2015). Arizona does not identify state forests separate from the U.S. Forest Service distinction of National Forests within the state. Rather, it manages forested areas as part of the park system and in cooperation with private landowners through Arizona State Forestry's Urban and Community Forestry Program (Arizona State Forestry, 2015).

3.1.8.6. Natural Areas

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 USC 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. Portions of two rivers, Fossil Creek and Verde River, have been designated National Wild and Scenic Rivers in Arizona (Figure 3.1.8-3 and Figure 3.1.8-5). A portion of Fossil Creek is also a designated recreational river (National Wild and Scenic Rivers System, 2015b). Arizona does not designate separate state wild, scenic, or recreational rivers.

Figure 3.1.8-5: Verde River
Source: (National Wild and Scenic Rivers System, 2015c)

National Wildlife Refuges and State Wildlife Management Areas

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, 2015bj). There are nine NWRs in Arizona (Figure 3.1.8-3 and Table 3.1.8-7) (USFWS, 2015d). As an example, the Cabeza Prieta NWR is comprised of 860,000 acres and is managed for the protection of the Sonoran pronghorn, bighorn sheep and the lesser long-nosed bat (USFWS, 2013a). Visual resources within this NWR include a granite mountain peak topped with lava, rugged mountain ranges, broad flat valleys, desert washes, and creosote bursage flats (USFWS, 2013h).

Table 3.1.8-7: Arizona National Wildlife Refuges

Bill Williams NWR	Imperial NWR
Buenos Aires NWR	Kofa NWR
Cabeza Prieta NWR	Leslie Canyon NWR
Cibola NWR	San Bernardino NWR
Havasu NWR	

Source: (USFWS, 2015d)

Additionally, the Arizona Game and Fish Commission "owns or manages more than 266,870 acres of land statewide, including wildlife areas, fish hatcheries, [and] shooting ranges" for public use (AZGFD, 2013d).

State Preserves and Natural Areas

Arizona is home to nature preserves managed by both private and public stakeholders. Arizona State Parks maintains three natural areas in accordance with its mission to "[manage] and [conserve] Arizona's natural, cultural and recreational resources for the benefit of the people. They are San Rafael State Natural Area, Sonoita Creek State Natural Area, and Verde River Greenway State Natural Area (see Figure 3.1.8-3) (Arizona State Parks, 2015c) (Arizona State Parks, 2015j). Visual resources in these areas include rolling hills, native grasses, oak trees, cottonwood trees, wildlife, riparian deciduous forests, creeks, and rivers (Arizona State Parks, 2015c). Additionally, BLM, U.S. Forest Service, and The Nature Conservancy cooperatively manage the Muleshoe Ranch Cooperative Management Area (CMA). The Muleshoe Ranch CMA is 49,120 acres of watershed for seven permanently flowing streams and represents the "best remaining aquatic habitat in southeast Arizona" (The Nature Conservancy, 2015a). The Nature Conservancy also manages nine other conservation areas: Aravaipa Canyon Preserve, Patagonia-Sonoita Creek Preserve, Ramsey Canyon Preserve, San Pedro River, Hassayampa River Preserve, Verde River, Bill Williams River, Colorado River, and Hart Prairie Preserve (The Nature Conservancy, 2015b). The Hassayampa River Preserve is jointly managed with the Maricopa County Parks and Recreation Department and houses desert wildlife where the mostly underground Hassayampa River breaks through the desert in the preserve, providing nourishment for cottonwood-willow forests, a rare and threatened forest type in North America (The Nature Conservancy, 2015c).

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership, and are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014d). These landmarks may be considered visual resources or visually sensitive. In Arizona, there are 10 NNLs (Table 3.1.8-8 and Figure 3.1.8-3). Some of the natural features located within these areas include the largest impact crater in the U.S. (Figure 3.1.8-6), the densest strand of Joshua trees in the U.S., and the "last permanent stream-bottom habitat areas in southern Arizona" (NPS, 2015m).

Figure 3.1.8-6: Barringer Meteor Crater

Source: (Public Domain Images, 2015)

Table 3.1.8-8: Arizona National Natural Landmarks

Barfoot Park	Kaibab Squirrel Area
Barringer Meteor Crater	Onyx Cav
Canelo Hills Cienega	Patagonia – Sonoita Creek Sanctuary
Comb Ridge	Ramsey Canyon
Grapevine Mesa Joshua Trees	Wilcox Plaza

Source: (NPS, 2015m)

National Conservation Areas

The BLM manages National Conservation Areas (NCA) designated by Congress to "conserve, protect, enhance, and manage public lands for the benefit and enjoyment of present and future generations." These areas are "landscapes with exceptional natural, recreational, cultural, wildlife, aquatic, archaeological, paleontological, historical, educational, or scientific resources or value." There are three NCAs in Arizona, the Gila Box Riparian, Las Cienegas, and San Pedro Riparian areas (Figure 3.1.8-3) (BLM, 2015e).

National Wilderness Areas

In 1964 Congress enacted the Wilderness Act of 1964 to "establish a National Wilderness Preservation System for the permanent good of the whole people" to provide "clean air, water, and habitat critical for rare and endangered plants and animals" (Wilderness.net 2015). 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" (Carhart, 2015). A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 NPS units (44 million acres) and part of the NPS system. Other designated wilderness areas are managed by the USFS, BLM, USFWS, and NPS (NPS, 2016k).

Arizona is home to 90 federally managed Wilderness Areas (Table 3.1.8-9 and Figure 3.1.8-3) (Wilderness.net, 2015).

Table 3.1.8-9: Arizona National Wilderness Areas

Apache Creek Wilderness	Mount Trumbull Wilderness
Aravaipa Canyon Wilderness	Mount Wilson Wilderness
Arrastra Mountain Wilderness	Mt. Wrightson Wilderness
Aubrey Peak Wilderness	Muggins Mountain Wilderness
Baboquivari Peak Wilderness	Munds Mountain Wilderness
Bear Wallow Wilderness	Needle's Eye Wilderness
Beaver Dam Mountains Wilderness	New Water Mountains Wilderness
Big Horn Mountains Wilderness	North Maricopa Mountains Wilderness
Cabeza Prieta Wilderness	North Santa Teresa Wilderness
Castle Creek Wilderness	Organ Pipe Cactus Wilderness
Cedar Bench Wilderness	Paiute Wilderness
Chiricahua National Monument Wilderness	Pajarita Wilderness
Chiricahua Wilderness	Paria Canyon-Vermilion Cliffs Wilderness
Cottonwood Point Wilderness	Peloncillo Mountains Wilderness
Coyote Mountains Wilderness	Petrified Forest National Wilderness Area
Dos Cabezas Mountains Wilderness	Pine Mountain Wilderness
Eagletail Mountains Wilderness	Pusch Ridge Wilderness
East Cactus Plain Wilderness	Rawhide Mountains Wilderness
Escudilla Wilderness	Red Rock-Secret Mountain Wilderness
Fishhooks Wilderness	Redfield Canyon Wilderness
Fossil Springs Wilderness	Rincon Mountain Wilderness
Four Peaks Wilderness	Saddle Mountain Wilderness
Galiuro Wilderness	Saguaro Wilderness
Gibraltar Mountain Wilderness	Salome Wilderness
Grand Wash Cliffs Wilderness	Salt River Canyon Wilderness
Granite Mountain Wilderness (AZ)	Santa Teresa Wilderness
Harcuvar Mountains Wilderness	Sierra Ancha Wilderness
Harquahala Mountains Wilderness	Sierra Estrella Wilderness
Hassayampa River Canyon Wilderness	Signal Mountain Wilderness
Havasu Wilderness	South Maricopa Mountains Wilderness
Hells Canyon Wilderness (AZ)	Strawberry Crater Wilderness
Hellsgate Wilderness	Superstition Wilderness
Hummingbird Springs Wilderness	Swansea Wilderness
Imperial Refuge Wilderness	Sycamore Canyon Wilderness
Juniper Mesa Wilderness	Table Top Wilderness
Kachina Peaks Wilderness	Tres Alamos Wilderness
Kanab Creek Wilderness	Trigo Mountain Wilderness
Kendrick Mountain Wilderness	Upper Burro Creek Wilderness
Kofa Wilderness	Wabayuma Peak Wilderness
Mazatzal Wilderness	Warm Springs Wilderness
Miller Peak Wilderness	West Clear Creek Wilderness
Mount Baldy Wilderness	Wet Beaver Wilderness
Mount Logan Wilderness	White Canyon Wilderness
Mount Nutt Wilderness	Woodchute Wilderness
Mount Tipton Wilderness	Woolsey Peak Wilderness

Source: (Wilderness.net, 2015)

3.1.8.7. 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. Arizona has five designated National Scenic Byways: Coronado Trail Scenic Byway, Historic Route 66, Kaibab Plateau-North Rim Parkway, Red Rock Scenic Byway, and Sky Island Scenic Byway (Figure 3.1.8-3). The Sky Island Scenic Byway is 27 miles of changing landscape and altitude from desert to conifer forests (AZDOT, 2015b).

Similar to National Scenic Byways, the Arizona Department of Transportation administers the Arizona Scenic Roads program recognizing three types of state roadways: scenic roads, historic roads, and parkways. There are 19 state scenic roads, 3 historic roads, and 4 parkways in Arizona (Table 3.1.8-10). Five of the state-designated scenic roads are also National Scenic Byways (Figure 3.1.8-3). (AZDOT, 2015b)

Table 3.1.8-10: Arizona State Scenic and Historic Byways

State Byway Name	Mileage
Apache Trail Historic Road	41.5
Copper Corridor Scenic Road East	38
Copper Corridor Scenic Road West	15
Coronado Trail National Scenic Byway*	103
Desert to Tall Pines Scenic Road	76.3
Dine Tah “Among the People” Scenic Road	100.3
Dry Creek Scenic Road	6.5
Fredonia – Vermillion Cliffs Scenic Road	82
Gila – Pinal Scenic Road	26
Historic Route 66* (Ash Fork to Lupton)	30.2
Historic Route 66* (Topcock to Ash Fork)	152
Jerome – Clarkdale – Cottonwood Historic Road	10
Joshua Forest Scenic Road (Wikieup to Wickenburg)	53.5
Kaibab Plateau – North Rim National Scenic Byway*	30.3
Kayenta – Monument Valley Scenic Road	27.7
Mingus Mountain Scenic Road	11.5
Naat’tsis’aan “Navajo Mountain” Scenic Road	58
Organ Pipe Cactus Parkway	25
Patagonia – Sonoita Scenic Road	52.5
Red Rock Scenic Byway*	7.5
San Francisco Peaks Scenic Road	31
Sedona – Oak Creek Canyon Scenic Road	15
Sky Island Parkway National Scenic Byway*	27.2
Swift Trail Parkway	26
Tse-nikani “Flat Mesa Rock” Scenic Road	43.4
White Mountain Scenic Road	67.3
White River Scenic Road	11.9

Source: (Arizona Scenic Roads, 2015)

*Also a National Scenic Byway.

3.1.9. Socioeconomics

3.1.9.1. 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 USC § 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. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This 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 (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders). This PEIS addresses environmental justice in a separate section (Section 3.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use and recreation (Section 3.1.7), infrastructure (Section 3.1.1), and aesthetic considerations (Section 3.1.9).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau[132] (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures

[132] 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

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 are based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016).

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

3.1.9.2. 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.

3.1.9.3. Communities and Populations

This section discusses the population and major communities of Arizona and includes the following topics:

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

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.

Statewide Population and Population Growth

Table 3.1.9-1 presents the 2014 population and population density of Arizona in comparison to the West region[133] and the nation. The estimated population of Arizona in 2014 was 6,731,484. The population density was 56 persons per square mile (sq. mi.), which was lower than the population density of both the region (98 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Arizona was the 15th largest state by population among the 50 states and the District of Columbia, 6th largest by land area, and had the 34th greatest population density (U.S. Census Bureau, 2015d; U.S. Census Bureau, 2015e).

Table 3.1.9-1: Land Area, Population, and Population Density of Arizona

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Arizona	113,594	6,731,484	56
West Region	624,241	61,039,316	98
United States	3,531,905	318,857,056	90

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

Population growth is an important subject for this PEIS, given FirstNet's mission. Table 3.1.9-2 presents the population growth trends of Arizona from 2000 to 2014 in comparison to the West region and the nation. The state's annual growth rate declined from 2.22 percent in the 2000 to 2010 period to 1.30 percent in the 2010 to 2014 period. The growth rate of Arizona in the latter period was slightly higher than the growth rate of the region, 1.08 percent. Both the region and the nation showed lower growth rates in both periods compared to the Arizona's growth rates.

Table 3.1.9-2: Recent Population Growth of Arizona

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
Arizona	5,130,632	6,392,017	6,731,484	1,261,385	339,467	2.22%	1.30%
West Region	51,610,010	58,469,720	61,039,316	6,859,710	2,569,596	1.26%	1.08%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

[a] Sources: (U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015f)
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 3.1.9-3 presents

[133] The West region is comprised of the states of Arizona, California, Idaho, Nevada, Oregon, and Washington. Throughout the socioeconomics section, figures for the West 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 West region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia's Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data and analysis service (ProximityOne, 2015) (University of Virginia 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 Arizona's population will increase by approximately 1,585,673 people, or 23.6 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 1.33 percent, which is similar to the historical growth rate from 2010 to 2014 of 1.30 percent. The projected growth rate of the state is higher than both the projected growth rate of the region (1.03 percent) and the nation (0.80 percent).

Table 3.1.9-3: Projected Population Growth of Arizona

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) 2014 to 2030
Arizona	6,731,484	8,778,792	7,855,522	8,317,157	1,585,673	23.6%	1.33%
West Region	61,039,316	73,661,854	70,107,981	71,884,918	10,845,602	17.8%	1.03%
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, 2015f; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)
AARC = Average Annual Rate of Change (compound growth rate)

Population Distribution and Communities

Figure 3.1.9-1 presents the distribution and relative density of the population of Arizona. 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, 2015i).

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, 2012b; U.S. Census Bureau, 2015j). 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. In Arizona's case, there are few close groupings of dots outside of the 10 largest population concentrations, indicating smaller concentrations. Figure 3.1.9-1 shows that much of Arizona is very sparsely populated.

Table 3.1.9-4 provides the populations of the 10 largest population concentrations in Arizona, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[134] In 2010, the largest population concentration by far was the Phoenix/Mesa area, which had over 3.6 million people. The state had no other population concentrations over 1 million and only one over 500,000 (i.e., the Tucson area, 843,168 people). All other areas had populations between 197,041 (Avondale/Goodyear) and 48,476 (Bullhead City, Arizona portion). The fastest growing area, by average annual rate of change from 2000 to 2010, was the Casa Grande area, with an annual growth rate of 5.58 percent. However, this area had a large increase in its area definition. The area expansion may have taken in some existing populations; thus, its growth rate may reflect this factor as well as organic growth (net in-migration and/or births exceeding deaths). None of the 10 largest population concentrations experienced population declines during this period.

Table 3.1.9-4 also shows that the top 10 population concentrations in Arizona accounted for 80.8 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 92.8 percent of the entire state's growth.

[134] 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.

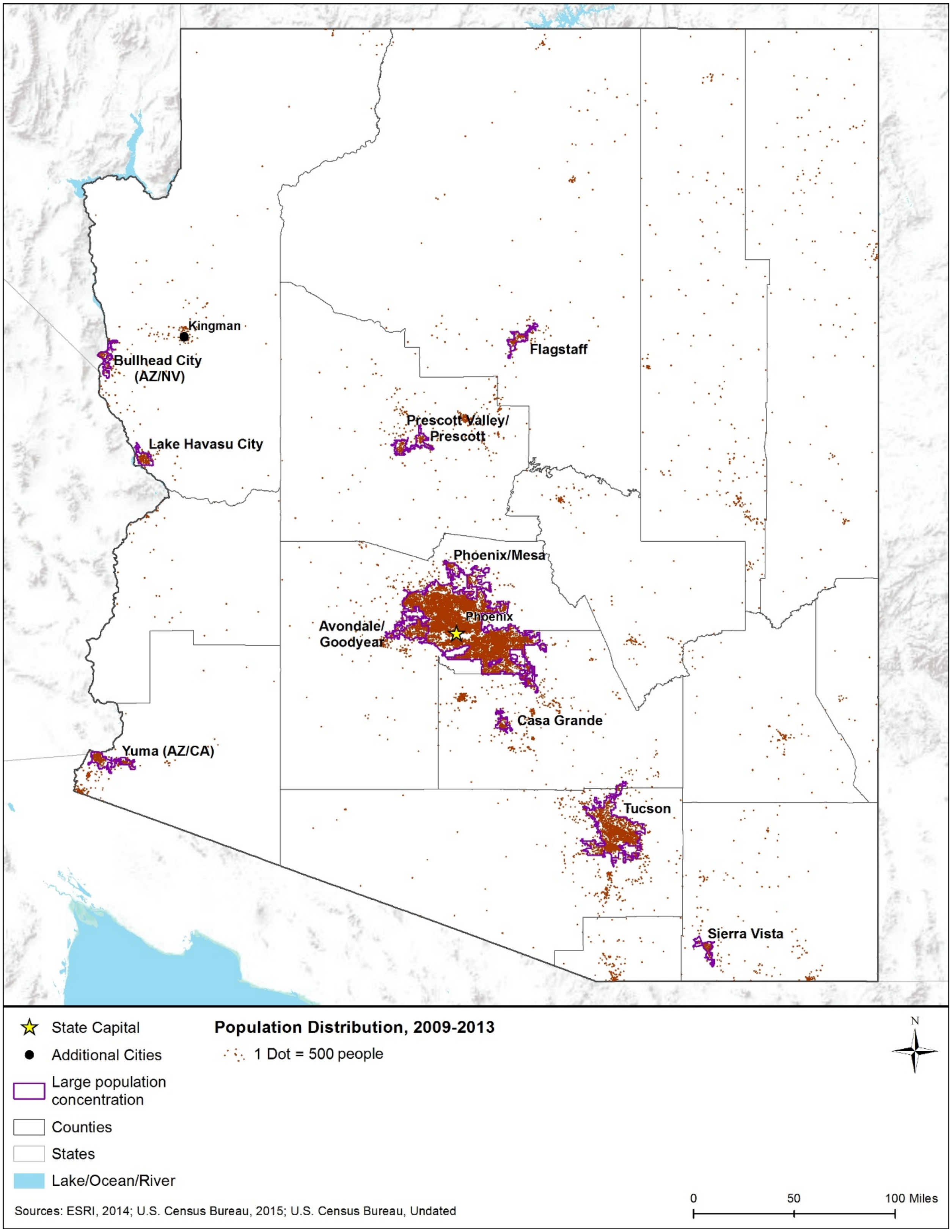

Figure 3.1.9-1: Population Distribution in Arizona, 2009–2013

Table 3.1.9-4: Population of the 10 Largest Population Concentrations in Arizona

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Avondale/Goodyear*	NA	197,041	201,324	3	NA	NA
Bullhead City (AZ/NV) (AZ Portion)	36,301	48,476	48,525	10	12,175	2.93%
Casa Grande**	29,815	51,331	52,746	9	21,516	5.58%
Flagstaff	57,050	71,957	73,559	6	14,907	2.35%
Lake Havasu City	42,787	53,427	53,980	7	10,640	2.25%
Phoenix/Mesa	2,907,049	3,629,114	3,699,686	1	722,065	2.24%
Prescott Valley/Prescott	61,909	84,744	85,767	5	22,835	3.19%
Sierra Vista	46,941	52,745	51,632	8	5,804	1.17%
Tucson	720,425	843,168	851,934	2	122,743	1.59%
Yuma (AZ/CA) (AZ Portion)	93,855	134,256	135,816	4	40,401	3.64%
Total for Top 10 Population Concentrations	**3,996,132**	**5,166,259**	**5,254,969**	**NA**	**1,170,127**	**2.60%**
Arizona (statewide)	**5,130,632**	**6,392,017**	**6,479,703**	**NA**	**1,261,385**	**2.22%**
Top 10 Total as Percentage of State	**77.9%**	**80.8%**	**81.1%**	**NA**	**92.8%**	**NA**

Sources: (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015ab; U.S. Census Bureau, 2015k)
AARC = Average Annual Rate of Change (compound growth rate)
*The Census Bureau did not define an "Avondale/Goodyear" urban area in 2000. The area defined as "Avondale/Goodyear" in 2010 is comprised of areas that were not included in any 2000 urban areas, as well as portions of the following 2000 urban areas: Avondale, Buckeye, Goodyear North, and Phoenix/Mesa.
**The large population increase from 2000 to 2010 reflects a change in the area definition for the Casa Grande area, from 16 sq. mi. in 2000 to 22 sq. mi. in 2010.

3.1.9.4. 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 3.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 3.1.9-5 compares several economic indicators for Arizona to the West region and the nation. The table presents two indicators of income[135] – 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 3.1.9-5, the per capita income in Arizona in 2013 ($25,164) was $3,494 lower than that of the region ($28,658), and $3,020 lower than that of the nation ($28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 3.1.9-5 shows that in 2013, the MHI in Arizona ($48,504) was $8,567 lower than that of the region ($57,071), and $3,746 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 3.1.9-5 compares the unemployment rate in Arizona to the West region and the nation. In 2014, Arizona's statewide unemployment rate of 6.9 percent was lower than the rate for the region (7.2 percent) and higher than the rate for the nation (6.2 percent).[136]

Table 3.1.9-5: Selected Economic Indicators for Arizona

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Arizona	$25,164	$48,504	6.8%
West Region	$28,658	$57,071	7.2%
United States	$28,184	$52,250	6.2%

Sources: (BLS, 2015b; U.S. Census Bureau, 2015g; U.S. Census Bureau, 2015l; U.S. Census Bureau, 2015m)

[135] 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, 2015p)

[136] The unemployment rates can change quarterly.

Figure 3.1.9-2 and Figure 3.1.9-2 show how MHI in 2013 (U.S. Census Bureau, 2015g) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 3.1.9-1 (U.S. Census Bureau, 2012b; U.S. Census Bureau, 2015j). Following these two maps, Table 3.1.9-6 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 Arizona.

Figure 3.1.9-2 shows that all counties with in Arizona had MHI levels below the national median, with the exception of one county (i.e., Greenlee) on the Arizona-New Mexico border. Table 3.1.9-6 shows that MHI in the Avondale/Goodyear, Flagstaff, Phoenix/Mesa, and Sierra Vista areas was above the state average ($49,774). MHI in all other population concentrations was below the state average. MHI was highest in the Avondale/Goodyear area ($63,160) and lowest in the Arizona portion of the Bullhead City area ($38,437).

Figure 3.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that only two counties around the Phoenix/Mesa, Avondale/Goodyear, and Tucson areas had unemployment rates below the national average (that is, better employment performance). The remainder of the state had unemployment rates above the national average. When comparing unemployment in the population concentrations to the state average (Table 3.1.9-6), most areas had a 2009–2013 unemployment rate that was similar to (within one percentage point) or higher than the state average (10.4 percent). Only two areas (i.e., Flagstaff and Sierra Vista areas) had unemployment rates considerably lower than the state average. Unemployment was highest in the Arizona portion of the Bullhead City area (17.2 percent).

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 3.1.9-7 provides figures on employment percentages by type of worker and by industry based on surveys conducted in 2013 by the Census Bureau. By class of worker (type of worker: private industry, government, self-employed, etc.), the percentage of private wage and salary workers was slightly higher in Arizona than in the West region, and slightly lower than the nation. The percentage of government workers was slightly higher in the state than in the region and nation. The percentage of self-employed workers was lower in the state when compared to the region and the nation.

By industry, Arizona has a mixed economic base and some notable figures in the table are as follows. Arizona in 2013 had a considerably lower percentage of persons working in "manufacturing" than did the region or the nation. It had a considerably higher percentage of workers in "educational services, and health care and social assistance" than the region. All other industries had employment percentages that were similar to (within one percentage point of) the figures for the region.

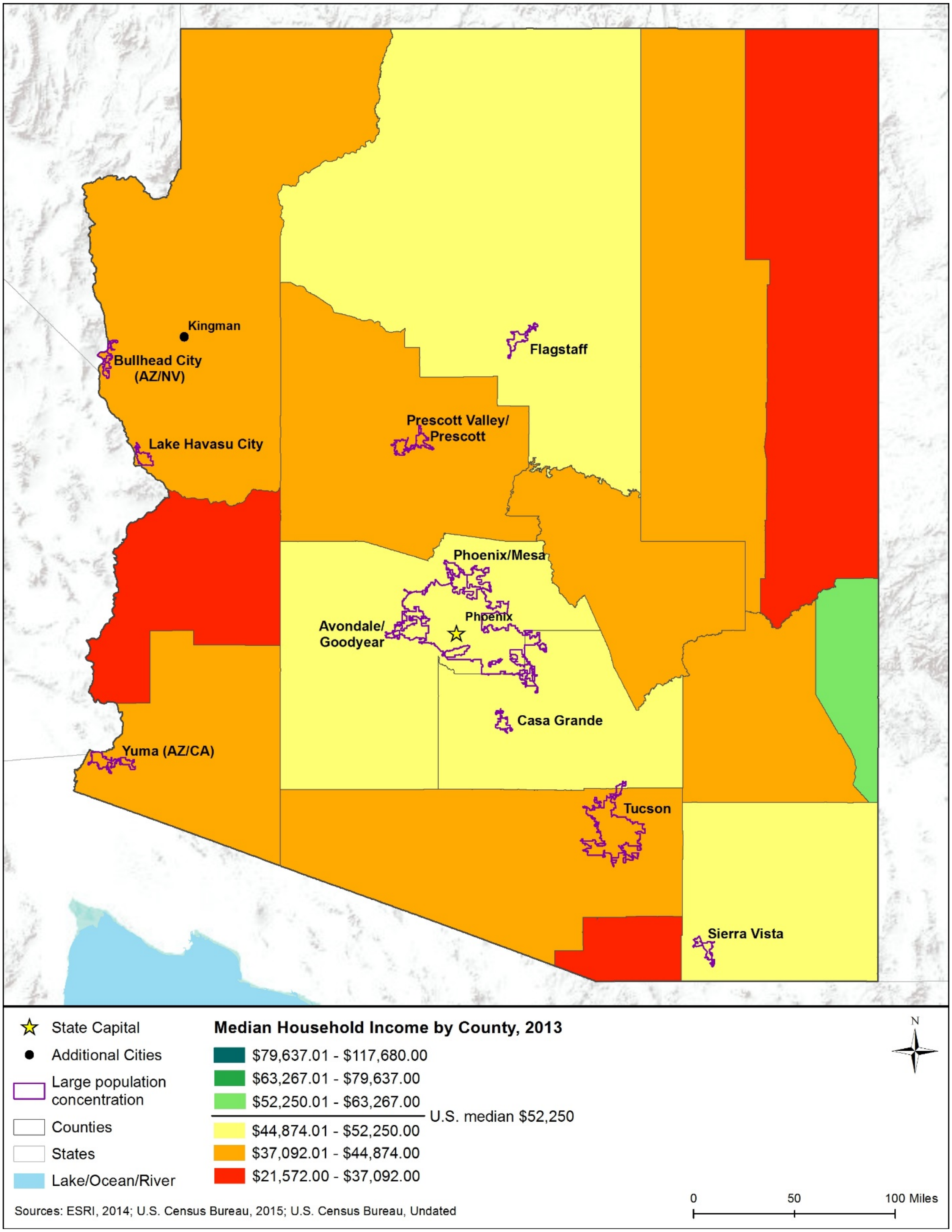

Figure 3.1.9-2: Median Household Income in Arizona, by County, 2013

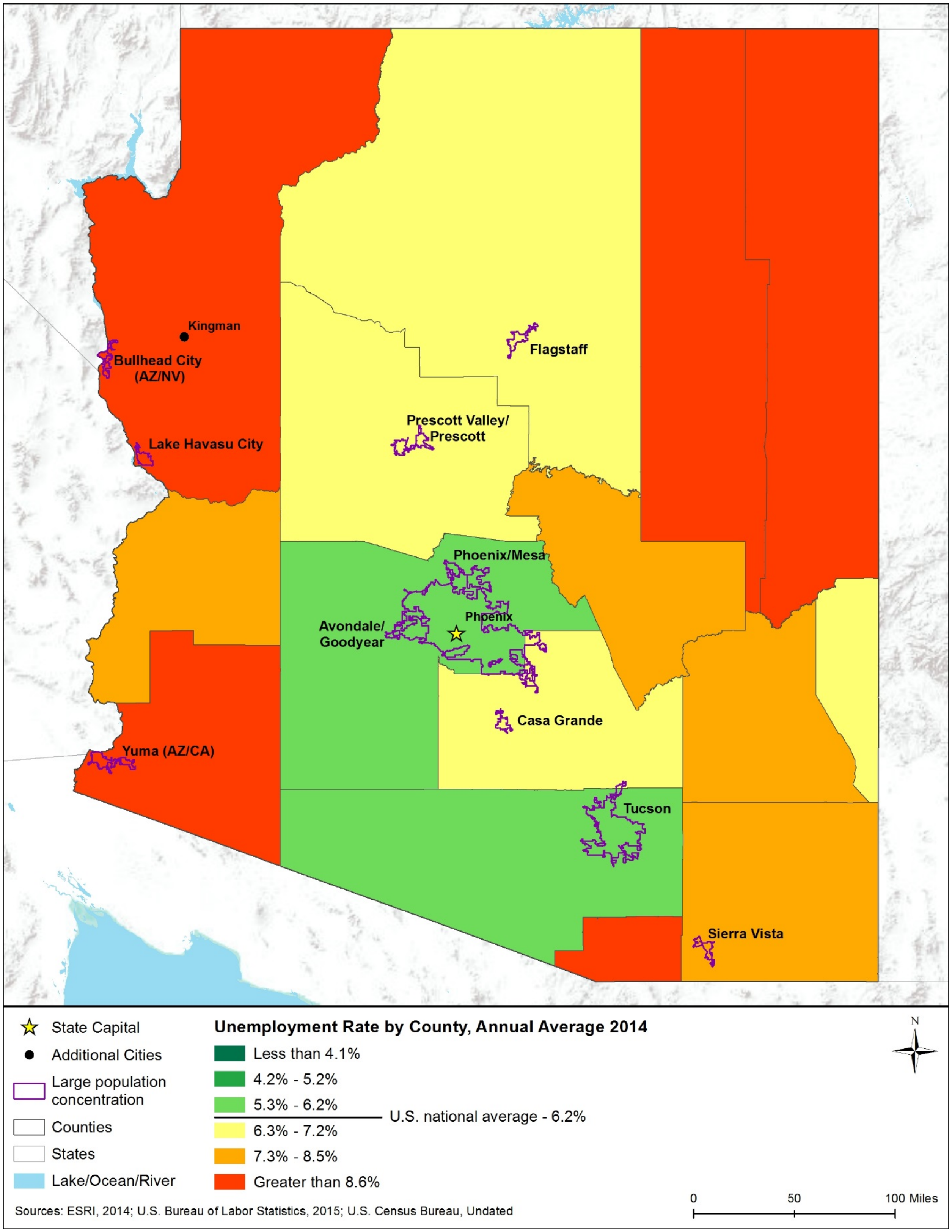

Figure 3.1.9-3: Unemployment Rates in Arizona, by County, 2014

Table 3.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Arizona, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Avondale/Goodyear	$63,160	9.7%
Bullhead City (AZ/NV) (AZ Portion)	$38,437	17.2%
Casa Grande	$45,162	13.0%
Flagstaff	$50,258	7.9%
Lake Havasu City	$42,134	10.6%
Phoenix/Mesa	$52,777	9.6%
Prescott Valley/Prescott	$43,010	10.2%
Sierra Vista	$59,238	8.2%
Tucson	$43,940	11.1%
Yuma (AZ/CA) (AZ Portion)	$44,311	12.2%
Arizona (statewide)	$49,774	10.4%

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

Table 3.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Arizona	West Region	United States
Civilian Employed Population 16 Years and Over	2,791,546	26,912,315	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.3%	78.4%	79.7%
Government workers	14.7%	13.9%	14.1%
Self-employed in own not incorporated business workers	5.9%	7.5%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	1.6%	2.5%	2.0%
Construction	6.7%	6.1%	6.2%
Manufacturing	7.5%	9.5%	10.5%
Wholesale trade	2.3%	2.9%	2.7%
Retail trade	12.2%	11.6%	11.6%
Transportation and warehousing, and utilities	4.8%	4.7%	4.9%
Information	1.8%	2.6%	2.1%
Finance and insurance, and real estate and rental and leasing	7.7%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	11.9%	12.3%	11.1%
Educational services, and health care and social assistance	22.2%	20.9%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	10.9%	10.9%	9.7%
Other services, except public administration	4.9%	5.2%	5.0%
Public administration	5.4%	4.6%	4.7%

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

Table 3.1.9-8 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 3.1.9-7 for 2013.

Table 3.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Arizona, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Avondale/Goodyear	5.4%	8.5%	1.6%	10.6%
Bullhead City (AZ/NV) (AZ Portion)	6.3%	5.3%	0.7%	4.8%
Casa Grande	6.1%	4.4%	2.1%	5.4%
Flagstaff	4.9%	3.5%	0.9%	7.0%
Lake Havasu City	8.8%	5.1%	1.7%	7.8%
Phoenix/Mesa	6.8%	4.8%	2.0%	12.9%
Prescott Valley/Prescott	6.8%	4.1%	1.8%	9.0%
Sierra Vista	3.4%	3.2%	1.5%	17.3%
Tucson	6.3%	4.0%	1.8%	11.6%
Yuma (AZ/CA) (AZ Portion)	5.1%	3.2%	1.7%	10.6%
Arizona (statewide)	6.7%	4.9%	1.8%	11.6%

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

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 3.1.9-9 compares Arizona to the West region and nation on several common housing indicators.

As shown in Table 3.1.9-9 in 2013, Arizona had a lower percentage of housing units that were occupied (83.0 percent) than the region (89.9 percent) or nation (87.6 percent). Of the occupied units, Arizona had a higher percentage of owner-occupied units (62.1 percent) than the region (56.8 percent), and a somewhat lower percentage than the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Arizona in 2013 (63.7 percent) was slightly higher than the region (60.3 percent) and nation (61.5 percent). The homeowner vacancy rate in Arizona (2.9 percent) was higher than the rate for the region (1.6 percent) and the nation (1.9 percent). This rate reflects, "vacant units that are 'for sale only" (U.S. Census Bureau, 2015p). The vacancy rate among rental units in Arizona, at 8.9 percent, was considerably higher than the rate of the region (5.1 percent) and the nation (6.5 percent).

Table 3.1.9-9: Selected Housing Indicators for Arizona, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Arizona	2,892,359	83.0%	62.1%	2.9%	8.9%	63.7%
West Region	23,159,156	89.9%	56.8%	1.6%	5.1%	60.3%
United States	132,808,137	87.5%	63.5%	1.9%	6.5%	61.5%

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

Table 3.1.9-10 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 3.1.9-10 shows that during this period the percentage of occupied housing units ranged between 68.6 to 88.0 percent across these population concentrations; the state percentage was 82.9 percent.

Table 3.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Arizona, 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
Avondale/Goodyear	72,683	86.4%	65.1%	4.5%	9.7%	82.0%
Bullhead City (AZ/NV) (AZ Portion)	27,991	72.1%	63.4%	5.0%	10.2%	51.9%
Casa Grande	23,038	79.8%	69.6%	3.2%	16.7%	64.0%
Flagstaff	29,556	86.8%	47.8%	3.2%	5.7%	47.1%
Lake Havasu City	33,887	68.6%	70.1%	4.2%	5.6%	78.6%
Phoenix/Mesa	1,584,388	85.5%	62.4%	3.3%	10.5%	63.0%
Prescott Valley/Prescott	42,730	85.9%	64.8%	3.4%	6.1%	65.2%
Sierra Vista	23,197	86.1%	60.2%	4.2%	12.5%	63.7%
Tucson	377,181	88.0%	59.7%	2.3%	9.5%	57.7%
Yuma (AZ/CA) (AZ Portion)	66,028	77.7%	67.6%	3.1%	10.1%	48.7%
Arizona (statewide)	2,859,768	82.9%	64.4%	3.4%	10.0%	63.3%

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

Property Values

Property values have important relationships to both the wealth and affordability of communities. Table 3.1.9-11 provides indicators of residential property values for Arizona and compares these values to values for the West 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, 2015p).

Table 3.1.9-11: Residential Property Values in Arizona, 2013

Geography	Median Value of Owner-Occupied Units
Arizona	$166,000
West Region	$301,787
United States	$173,900

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

Table 3.1.9-12 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 values in the 10 top population concentrations in Arizona ranged from $109,700 in the Casa Grande area to $254,100 in the Flagstaff area. The state median value was $165,100.

Table 3.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Arizona, 2009–2013

Area	Median Value of Owner-Occupied Units
Avondale/Goodyear	$160,600
Bullhead City (AZ/NV) (AZ Portion)	$117,500
Casa Grande	$109,700
Flagstaff	$254,100
Lake Havasu City	$193,600
Phoenix/Mesa	$173,400
Prescott Valley/Prescott	$192,400
Sierra Vista	$189,700
Tucson	$166,200
Yuma (AZ/CA) (AZ Portion)	$118,800
Arizona (statewide)	$165,100

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes are a subcategory of selective sales taxes that includes taxes on provided 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 3.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

General and selective sales taxes may change, reflecting expenditures during system development and maintenance. Table 3.1.9-13 shows that state and local governments in Arizona received less total revenue in 2012 on a per capita basis than their counterpart governments in the region and nation. The Arizona state government had higher levels per capita of intergovernmental revenues[137] from the federal government than its regional counterparts did, and lower levels compared to its counterparts in the nation. Local governments in Arizona had lower levels per capita of intergovernmental revenues from the federal government than their counterparts in both the region and the nation. The Arizona state government obtained considerably lower levels of property taxes per capita than state governments in the region, but slightly higher levels than its counterparts in the nation. Local governments in Arizona obtained lower levels of property taxes per capita than local governments in the region and nation. General sales taxes were higher on a per capita basis for the Arizona state and local governments than for their counterparts in the region and nation. Selective sales tax revenues for Arizona's state government were slightly higher on a per capita basis than state governments in the region, and lower when compared to counterparts in the nation. Selective sales tax revenues for local governments in Arizona were lower on a per capita basis than for local governments in both the region and nation. Per capita public utility tax revenues specifically, for the state and local governments in Arizona, were considerably lower when compared to counterparts in the region and nation. Individual and corporate income tax revenues, on a per capita basis, were higher for Arizona's state government than for its counterparts in the region, and lower when compared to the nation's counterparts. Arizona state and local governments did not report revenue from individual and corporate income taxes.

[137] Intergovernmental revenues are those revenues received from the federal government or other government entities such as shared taxes, grants, or loans and advances.

Table 3.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue*		Arizona		Region		United States	
		State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue	**($M)**	**$32,134**	**$27,091**	**$372,535**	**$354,200**	**$1,907,027**	**$1,615,194**
	Per capita	**$4,904**	**$4,132**	**$6,235**	**$5,928**	**$6,075**	**$5,145**
Intergovernmental from Federal	($M)	$10,395	$958	$44,368	$15,822	$514,139	$70,360
	Per capita	$1,586	$147	$743	$265	$1,638	$224
Intergovernmental from State	($M)	$0	$7,031	$87,966	$117,358	$0	$469,147
	Per capita	$0	$1,076	$1,472	$1,964	$0	$1,495
Intergovernmental from Local	($M)	$358	$0	$880	$0	$19,518	$0
	Per capita	$55	$0	$15	$0	$62	$0
Property Taxes	($M)	$754	$6,093	$52,387	$71,927	$13,111	$432,989
	Per capita	$115	$930	$877	$1,204	$42	$1,379
General Sales Taxes	($M)	$6,211	$2,373	$31,184	$14,896	$245,446	$69,350
	Per capita	$948	$367	$522	$249	$782	$221
Selective Sales Taxes	($M)	$1,855	$278	$13,934	$7,418	$133,098	$28,553
	Per capita	$283	$45	$233	$124	$424	$91
Public Utilities Taxes	($M)	$21	$178	$3,644	$4,323	$14,564	$14,105
	Per capita	$3	$28	$61	$72	$46	$45
Individual Income Taxes	($M)	$3,094	$0	$10,133	$0	$280,693	$26,642
	Per capita	$472	$0	$170	$0	$894	$85
Corporate Income Taxes	($M)	$648	$0	$1,270	$52	$41,821	$7,210
	Per capita	$99	$0	$21	$1	$133	$23

Sources: (U.S. Census Bureau, 2015s; U.S. Census Bureau, 2015t)

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

3.1.10. Environmental Justice

3.1.10.1. 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).[138] The fundamental principle of environmental justice is, "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies" (USEPA, 2016c). Under the EO, each federal agency must "make achieving environmental justice part of its mission by identifying and addressing, as appropriate,

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

disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 2013).

In 1997, the Council on Environmental Quality (CEQ) issued Environmental Justice: Guidance under the National Environmental Policy Act (NEPA) to assist federal agencies in meeting the requirements of the EO (CEQ, 1997). Additionally, USEPA) Office of Environmental Justice (USEPA, 2015f) *o*ffers 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 U.S. Census Bureau (Census Bureau).
- Environmental effects include social and economic effects. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment." (CEQ, 1997)

3.1.10.2. 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. Arizona does not have formal policies or programs to address environmental justice. However, as of 2009, Arizona's Department of Environmental Quality Office of Administrative Counsel had a full-time position dedicated to the coordination and response of environmental justice concerns and complaints (University of California, Hastings College of Law, 2010).

3.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 3.1.10-1 presents 2013 data on the composition of Arizona's population by race and by Hispanic origin. Arizona's population has considerably lower percentages of individuals who identify as Black/African American (4.2 percent) and Asian (2.9 percent) than the populations of the West region and the nation. Those percentages are, for Black/African American, 5.2 percent for the West region and 12.6 percent for the nation, and for Asian, 10.5 percent and 5.1 percent, respectively. Arizona's percentage of individuals who identify as Some Other Race (6.2 percent) is lower than that of the Central region (10.0 percent) and slightly higher than the nation's percentage (4.7 percent). Arizona has a higher percentage for American Indian/Alaska Native (4.4 percent) than either the West region (1.3 percent) or the nation (0.8 percent). The state's population of persons identifying as White (79.0 percent) is larger than that of the West region (68.3 percent) or the nation (73.7 percent).

The percentage of the population in Arizona that identifies as Hispanic (30.3 percent) is slightly smaller than in the West region (31.5 percent), but considerably larger than in 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. Arizona's All Minorities population percentage (43.4 percent) is lower than that of the region (51.2 percent) and higher than that of the nation (37.6 percent). Table 3.1.10-2 the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Arizona (18.6 percent) is higher than that for the West region (16.6 percent) and the nation (15.8 percent).

Table 3.1.10-1: Population by Race and Hispanic Status, 2013

Geography	Total Population (estimated)	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian/ Pacific Islander	Some Other Race	Two or More Races		
Arizona	6,626,624	79.0%	4.2%	4.4%	2.9%	0.2%	6.2%	3.2%	30.3%	43.4%
West Region	60,262,888	68.3%	5.2%	1.3%	10.5%	0.4%	10.0%	4.3%	31.5%	51.2%
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, 2015u)
"All Minorities" is defined as all persons who consider themselves Hispanic or of any race other than White. Because some Hispanics identify as both Hispanic and of a non-White race, "All Minorities" is less than the sum of Hispanics and non-White races.

Table 3.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Arizona	18.6%
West Region	16.6%
United States	15.8%

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

3.1.10.4. 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.

Figure 3.1.10-1 visually portrays the results of the environmental justice population screening analysis for Arizona. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015w; U.S. Census Bureau, 2015x; U.S. Census Bureau, 2015y; U.S. Census Bureau, 2015z) and Census Bureau urban classification data (U.S. Census Bureau, 2012b) (U.S. Census Bureau, 2015aa).

Figure 3.1.10-1 shows that a high proportion of Arizona has high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state.

It is important to understand how the data behind Figure 3.1.10-1 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 3.1.10-1 does not definitively identify environmental justice populations. It indicates *degrees of likelihood of the presence* of populations of potential concern from an environmental justice perspective. Two caveats are important. First, environmental justice communities are often highly localized. Block group data may under- or over-represent the presence of these localized communities. For instance, in the large block groups in sparsely populated regions of the state, the data may represent dispersed individuals of minority or low-income status rather than discrete, place-based communities. Second, the definition of the moderate potential category draws a wide net for potential environmental justice populations. As discussed in Appendix D, the definition includes some commonly used thresholds for environmental justice screening that tend to over-identify environmental justice potential. Before FirstNet deploys projects, additional site-specific analyses to identify specific, localized environmental justice populations may be warranted. Such analyses could tier-off the methodology of this PEIS.

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to significance criteria), and "appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group" (CEQ, 1997). The Environmental Consequences section (Section 3.2) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

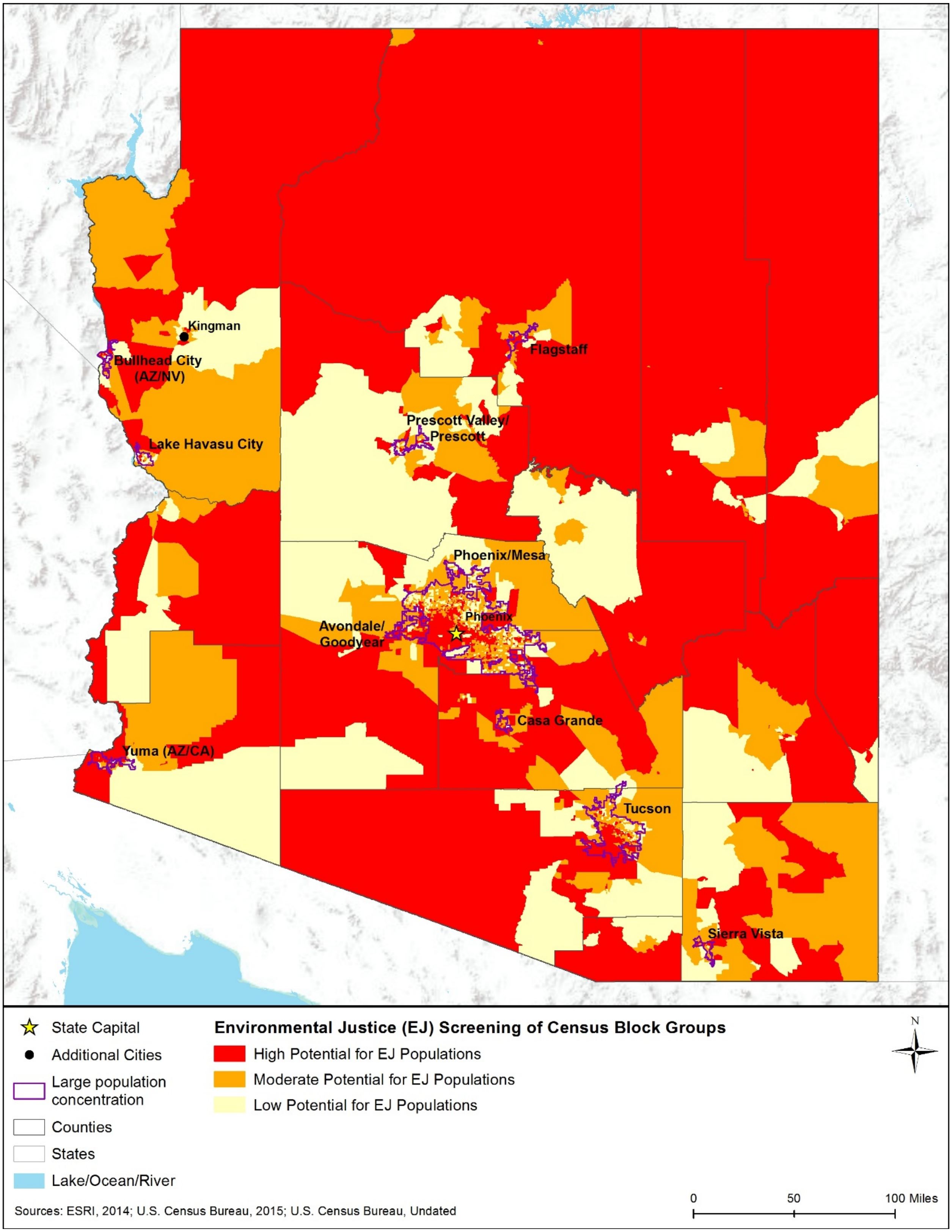

Figure 3.1.10-1: Potential for Environmental Justice Populations in Arizona, 2009–2013

3.1.11. Cultural Resources

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

3.1.11.2. Specific Regulatory Consideration

The Proposed Action must meet the requirements of the NEPA and other applicable laws and regulations. Applicable federal laws and regulations that apply to Cultural Resources include the NHPA (detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders), the American Indian Religious Freedom Act (AIRFA), ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws.

Arizona has state statutes and regulations that are similar to the NHPA (refer to Table 3.1.11-1). However, federal statutes and regulations supersede those of the state. 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 3.1.11-1: Relevant Arizona Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Arizona State Historic Preservation Act (Arizona Revised Statutes §41-861 through §41-864)	Arizona State Historic Preservation Office (SHPO)	This Act mirrors the NHPA for state actions, requiring agencies to consult with SHPO regarding potential impacts to historic properties.

3.1.11.3. Cultural and Natural Setting

Human beings have inhabited Arizona for some 14,000 years (NPS, 2015q). The majority of Arizona's early human habitation evidence comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 134 archaeological sites listed on the NRHP in Arizona, of which there are 78 prehistoric sites, 34 historic archaeological sites, 22 that have historic and prehistoric provenance, and 1 shipwreck (Charles H. Spencer) (NPS, 2014f).

Archaeologists typically divide large study areas into regions. As shown in Figure 3.1.3-1, Arizona occupies only one physiographic region, the Intermontane Plateau. The region is subdivided into two physiographic provinces; the Colorado Plateaus encompass the northeastern section of the state, and Basin and Plain, which comprises of the majority of the land area.

Evidence at most archeological sites in Arizona come from relatively shallow deposits, within one to two feet of the surface, or on the surface. However, in some cases, natural factors buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers or peat deposits in wetlands. These deposits can range between one and ten 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).

The following sections provide additional detail about Arizona's prehistoric periods (approximately 12,000 B.C. to A.D. 1600) and the historic period since European contact in the 1500s and settlement in the late 1600s. Section 3.1.11.4 presents an overview of the initial human habitation in Arizona and the cultural development that occurred before European contact. Section 3.1.11.5 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 3.1.11.6 provides a current list of significant archaeological sites in Arizona and tools that the state has developed to ensure their preservation. Section 3.1.11.7 document the historic context of the state since European contact, and Section 3.1.11.8 summarizes the architectural context of the state during the historic period.

Prehistoric Setting

There are three distinct periods associated with the prehistoric human populations that inhabited present day Arizona and the greater central geography of North America: The Pre-Archaic period (12,000 to 8,000 B.C.), Early Archaic period (8,000 to 2,000 B.C.), Middle Archaic period (2,000 B.C. to A.D. 500), and the Late Archaic period (500 to A.D. 1600) (NPS, 2015q). Figure 3.1.11-1 shows a timeline representing these periods of early human habitation in North America, including present day Arizona. It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Evidence of human occupation in each of Arizona's physiographic regions is prevalent. Due to advancements in techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record, continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

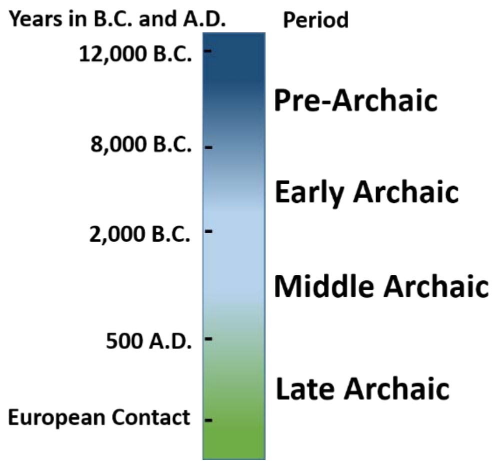

Figure 3.1.11-1: Timeline of Prehistoric Human Occupation

Source: (Institute of Maritime History, 2015)

Pre-Archaic Period (12,000 – 8,000 B.C.)

The Pre-Archaic Period represents the earliest human habitation Arizona, and dates back as far as 12,000 B.C. Many of the sites identified from this period are "ground surface" sites and yield very few artifacts. The earliest people to occupy the state were small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear points, also referred to as the Clovis fluted point. Recent studies show that such technology was prevalent in northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002). Most of the oldest known evidence of human settlement in Arizona is based on the discovery of multifunctional tools such as scrapers and gravers found in surface and shallow deposits throughout the state. Clovis period projectile points (arrowheads) from this region are from the typical Pre-Archaic people (often termed "Paleoindian" elsewhere) who renowned big-game hunters throughout North America were. Archaeologists hypothesize that the people of this period ranged across the state in small bands that followed migratory game. Early Pre-Archaic settlers used the Clovis fluted point technology to hunt large game known as megafauna such as mastodon and bison (Kelly, 2015; Rafferty, 1988). These bands established seasonal camps, some of which likely became permanent settlements. The people who inhabited this region during the Pre-Archaic are most likely related to those that migrated to North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch). There is very little evidence that people used plant-processing tools during this period (Roth, B., 1993).

The archaeological record from the Early Archaic period in Arizona is incomplete. However, there is evidence that projectile point technology was advancing, based on the increase in variation of types discovered in this region of the western United States. Hunting became more commonplace during this period. The mano and metate were stone tools used for the grinding of seeds into meal. The mano was a hand-held smoothed stone with a flattened side. The seeds were placed in the metate (stone bowl) and ground down using the mano. Figure 3.1.11-2 shows an example of a mano and metate and how it is used (NPS, 2015r). The people grounded the seeds to make a meal or flour to form a simple bread, presumably baked over an open flame. Sites from the Early Archaic in Arizona include caves and rock shelters, where the people stored their food.

Other evidence from the Early Archaic Period comes from various sites throughout the state. An example of such site located in south central Arizona, which contains stone projectile points (arrowheads). This particular site contains Cortaro points, which have been used as an indicator for dating other sites to Early Archaic in Arizona and across the southwestern United States (Roth & Huckell, 1992).

Figure 3.1.11-2: Example of Mano and Metate

Source: (NPS, 2015r)

By the Middle Archaic period, the people began live and store food in pit houses. Pit houses are underground shelters with hearths and food storage pits on the inside. Archaeological evidence suggests that the people were occupying and reoccupying these dwelling for many years. The people also used caves and rock shelters as a means for storing food and protecting themselves from the harsh desert-like environment (Roth & Freeman, 2008).

Due to the limited range of food sources associated with the desert-like environment, it became important for the people to be extremely efficient in various hunting practices within all the various ecological settings such as basins and ranges. An increase in trade continued during the Middle Archaic period, which is evident by the amount of exotic materials such as marine shell and obsidian. There was a gradual increase in average annual rainfall during this period, which gave way to increasing human populations in the region. Small ponds and lakes began to form which provided a new resource for the people to tap into for subsistence (Roth & Freeman, 2008).

Fish Valley, located in the western part of the Great Basin is an example of an area with sites from this period. The sites from Fish Valley are represent human occupation from the Middle Archaic and into the Late Archaic. Some of the sites are larger than 20 acres in size and diagnostic tools were found that show that people were occupying this region during this time.

As previously mentioned, an increase of precipitation in the region allowed for an increased abundance of food sources for the inhabitants (Rafferty, 1988). The people took advantage of the increase in trees, such as the pinyon pine, which flourished during the period. Pine nuts (seeds) were harvested from the cones of the pinyon pine and provided an added source of protein to their diet (Kelly, 2015).

Populations continued to increase during the Late Archaic period. Hunting practices continued to become more efficient due to the advent of the bow and arrow. By 2001, six sites have been identified from this period in Maricopa County, Arizona; prior to 2001, only one such site had been identified there. Two excavations at the Last Ditch Site provide evidence that the area's populations of people continued to increase during the Late Archaic. It also shows that the subsistence patterns of the people in this region was changing. The gathering and processing of plants for food and other purposes became more specialized, and required less people to accomplish tasks. The ability to expand on previous technology for processing plants was imperative for the survival the people from this period. Due to increased aridity and a limited supply of food sources, they had to become increasingly creative in the types of food they consumed and the way they prepared it (Hackbarth 2001).

Archaeologists use the study of tools, such as projectile points (arrowheads) to differentiate the different types of people that existed in the region during the same period. Elko-corner notched and San Pedro points are examples of such use of this method of distinguishing various groups of people of Arizona and the greater southwestern United States (Shackley 1996).

3.1.11.4. Federally Recognized Tribes of Arizona

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are 21 federally recognized Tribes in Arizona:

- Ak-Chin Indian Community of the Maricopa (Ak-Chin) Indian Reservation,
- Cocopah Tribe of Arizona,
- Colorado River Indian Tribes of the Colorado River Indian Reservation (Arizona and California),
- Fort McDowell Yavapai Nation,
- Fort Mojave Indian Tribe (Arizona, California and Nevada),
- Gila River Indian Community of the Gila River Indian Reservation,
- Havasupai Tribe of the Havasupai Reservation,
- Hopi Tribe of Arizona,
- Hualapai Indian Tribe of the Hualapai Indian Tribe Reservation,
- Kaibab Band of Paiute Indians of the Kaibab Indian Reservation,
- Navajo Nation (Arizona, New Mexico and Utah),
- Pascua Yaqui Tribe of Arizona,
- Quechan Tribe of the Fort Yuma Indian Reservation (Arizona and California),
- Salt River Pima-Maricopa Indian Community of the Salt River Reservation,
- San Carlos Apache Tribe of the San Carlos Reservation,
- San Juan Southern Paiute Tribe of Arizona,
- Tohono O'odham Nation of Arizona,

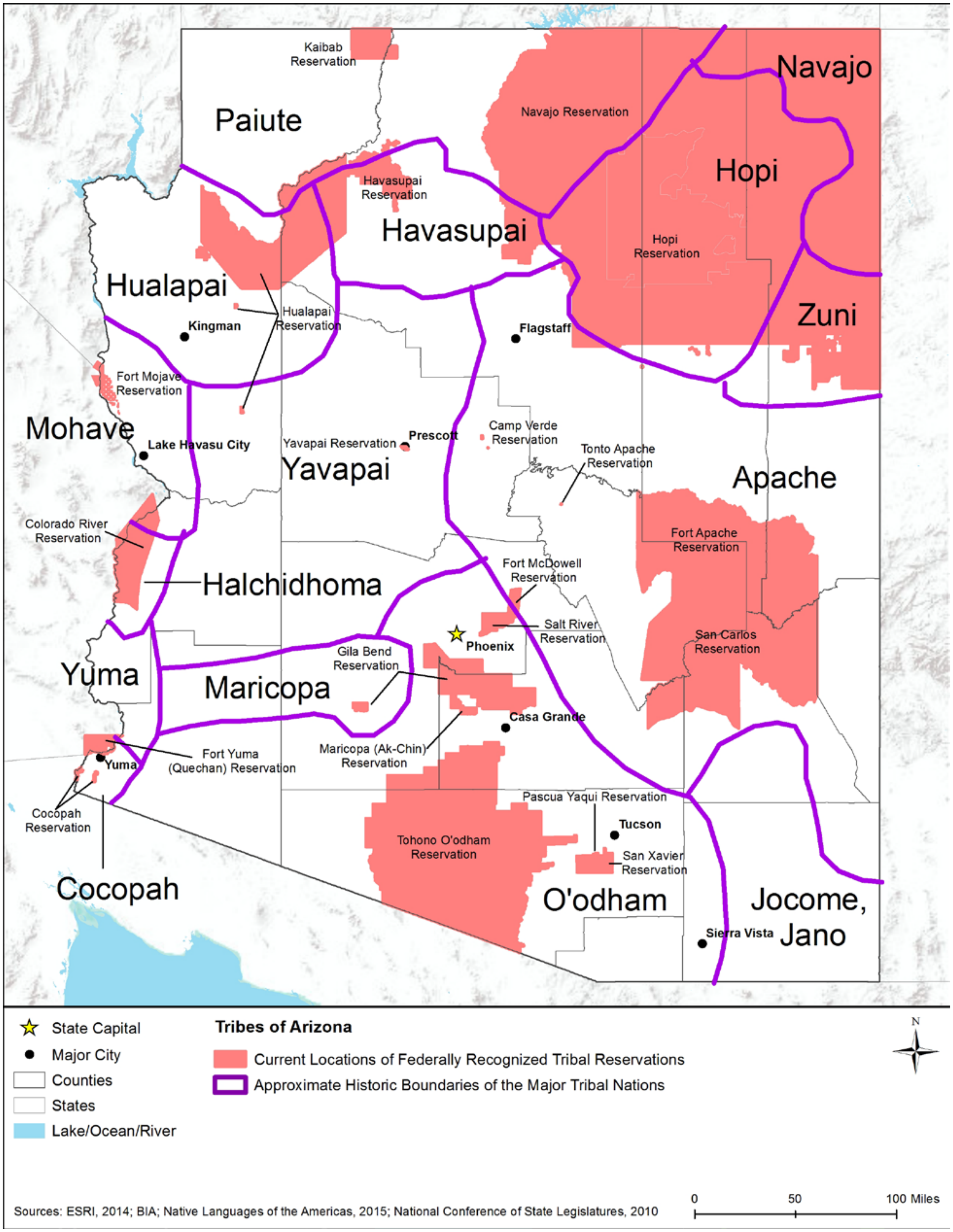

Figure 3.1.11-3: Federally Recognized Tribes in Arizona

- Tonto Apache Tribe of Arizona,
- Yavapai-Apache Nation of the Camp Verde Indian Reservation, and
- Yavapai-Prescott Tribe of the Yavapai Reservation (NRCS, 2015e; GPO, 2015).

The location of federally recognized tribes are shown in in Figure 3.1.11-4. The other tribes depicted on Figure 3.1.11-4 show the general locations of tribes that were known to exist in this region of the United States, but are not officially federally recognized.

3.1.11.5. Significant Archaeological Sites of Arizona

As previously mentioned in Section 3.1.11, there are 134 archaeological sites listed on the NRHP for Arizona. Table 3.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A complete listing of NRHP sites can be found on the NPS NRHP website at http://www.nps.gov/nr/ (NPS, 2014f).

Arizona State Cultural Resources Database and Tools

Arizona State Historic Preservation Office (SHPO)

The Arizona State Historic Preservation Office offers assistance in protecting and preserving properties of historic significance and also provides for a significant amount of community outreach and education. This office is responsible for coordinating multiple events every month at local state parks that aim to educate citizens to the unique historic and prehistoric treasures in Arizona. The ASPO is also a primary sponsor of the annual Arizona Historic Preservation Conference, which brings experts from around the world to focus on contemporary research of history and preservation. The organization hosts multiple resources on their website for those interested in additional information (AZDOT, 2015b).

Arizona Archaeological and Historical Society (AAHS)

The Arizona Archaeological and Historical Society has an almost 100-year history encouraging and aiding all aspects of historic preservation in the surrounding community. This organization works closely with the Arizona State Museum to offer educational and professional opportunities exploring the rich cultural history of the state. The AAHS publishes an internationally recognized quarterly journal, *Kiva*, which tracks the latest research of topics in southwestern anthropology and history. AAHS members are able to access past issues of the journal through the JSTOR digital library (Arizona Scenic Roads, 2015).

Table 3.1.11-2: Archaeological Sites on the National Register of Historic Places in Arizona

Closest City	Site Name	Type of Site
Adamana	Flattop Site	Prehistoric
Adamana	Newspaper Rock Petroglyphs Archeological District	Prehistoric
Adamana	Puerco Ruin and Petroglyphs	Prehistoric

Closest City	Site Name	Type of Site
Adamana	Twin Buttes Archeological District	Prehistoric
Apache Junction	Skeleton Cave Massacre Site	Historic- Aboriginal, Military
Apache Junction	Hieroglyphic Canyon Site	Historic- Aboriginal, Prehistoric
Bacavi	Bacavi (Paaqavi) Historic District	Historic - Aboriginal
Black Canyon	Perry Mesa Archeological District (Boundary Increase)	Prehistoric
Black Mesa	Standing Fall House	Prehistoric
Cameron	Tutuveni	Historic - Aboriginal, Prehistoric
Camp Verde	Clear Creek Pueblo and Caves	Prehistoric
Carefree	Brazaletes Pueblo Site	Prehistoric
Carefree	Sears--Kay Ruin	Prehistoric
Cashion	Cashion Archeological Site	Prehistoric
Chambers	Kin Tiel	Historic - Aboriginal, Prehistoric
Chandler	Midvale Archeological Site	Prehistoric
Cibecue	Grasshopper Ruin	Prehistoric
Clarkdale	Hatalacva Ruin	Prehistoric
Clarkdale	Tuzigoot National Monument Archeological District	Prehistoric
Colorado City	Antelope Cave	Prehistoric
Coolidge	Grewe Site	Prehistoric
Douglas	Double Adobe Site	Prehistoric
Douglas	Rucker Canyon Archeological District	Historic, Military, Prehistoric
Dragoon	Dragoon Springs Stage Station Site	Historic
Ehrenberg	Old La Paz	Historic - Aboriginal
Ehrenberg	Ripley Intaglios	Historic - Aboriginal, Prehistoric
Fairbank	Quiburi	Historic, Historic - Aboriginal, Prehistoric, Military
Fisher's Landing	Martinez Lake Site (AZ-050-0210)	Prehistoric
Flagstaff	Anderson Mesa Incline	Historic
Flagstaff	Archeological Site No. AR-03-04-03-810	Historic
Flagstaff	Archeological Site No. AR-03-04-03-811	Historic
Flagstaff	Elden Pueblo	Prehistoric
Flagstaff	Picture Canyon Archeological Site	Prehistoric
Flagstaff	Ridge Ruin Archeological District	Prehistoric
Flagstaff	Archeological Site No. AR-03-04-03-812	Historic
Flagstaff	Archeological Site No. AR-03-04-05-414	Historic
Flagstaff	Archeological Site. No. AR-03-04-05-440	Historic
Flagstaff	Saginaw & Manistee Camp 2	Historic
Florence	Adamsville Ruin	Historic - Aboriginal, Prehistoric
Fredonia	Bullethead	Prehistoric
Fredonia	Checkered Men	Prehistoric
Fredonia	Head Hunters	Prehistoric
Fredonia	Rock Family	Prehistoric

Closest City	Site Name	Type of Site
Fredonia	Rocketeers	Prehistoric
Fredonia	Twins	Prehistoric
Fredonia	White Man Cave	Prehistoric
Fredonia	Wise Men	Prehistoric
Gila Bend	Fortaleza	Prehistoric
Gila Bend	Gatlin Site	Prehistoric
Gila Bend	Sears Point Archaeological District	Prehistoric
Hereford	Lehner Mammoth-Kill Site	Prehistoric
Holbrook	Painted Desert Petroglyphs and Ruins Archeological District	Prehistoric
Hyder	Eagletail Petroglyph Site	Prehistoric
Keams Canyon	Awatovi Ruins	Historic - Aboriginal, Prehistoric
Kingman	Camp Beale Springs	Historic - Aboriginal, Prehistoric, Military
Kingman	Northern Avenue Petroglyph Site	Prehistoric
Lake Mead	Grand Wash Archeological District	Historic - Aboriginal, Prehistoric
Lee's Ferry	CHARLES H. SPENCER Hulk	Shipwreck
Lookout Mountain	Camp Grant Massacre Site	Prehistoric
Mesa	Archeological Site No. AZ U:10:20(ASU)	Prehistoric
Mesa	Archeological Site No. AZ U:10:25(ASU)	Prehistoric
Mesa	Mesa Grande	Prehistoric
Morenci	Point of Pines	Prehistoric
Naco	Naco-Mammoth Kill Site	Prehistoric
Nogales	Calabasas	Historic, Historic - Aboriginal
Oatman	Bighorn Cave	Prehistoric
Payson	Houston Mesa Ruins	Prehistoric
Peoria	Palo Verde Ruin	Prehistoric
Phoenix	Hedgpeth Hills Petroglyph Site	Prehistoric
Phoenix	Hohokam-Pima Irrigation Sites	Prehistoric
Phoenix	Perry Mesa Archeological District	Prehistoric
Picacho	McClellan Wash Archeological District	Prehistoric
Pinedale	Bailey Ruin	Prehistoric
Prescott	Fewkes’ Fort Below Aztec Pass (AR-03-09-06-23)	Prehistoric
Prescott	Indian Peak Ruin (AR-03-09-06-116)	Prehistoric
Punkin Center	Archeological Site No. AR-03-12-06-1130(TNF)	Historic
Punkin Center	Archeological Site No. AR-03-12-06-1131(TNF)	Historic
Punkin Center	Cline Terrace Platform Mound (AR-03-12-06-132 TNF)	Historic
Punkin Center	Oak Creek Platform Mound (AR-03-12-06-714 TNF)	Historic
Punkin Center	Park Creek Platform Mound (AR-03-12-06-1044 TNF)	Historic
Red Rock	Los Robles Archeological District	Prehistoric
Rimrock	Sacred Mountain	Prehistoric

Closest City	Site Name	Type of Site
Rio Verde Estates	Azatlan Archeological Site	Prehistoric
Roosevelt	Tonto National Monument Archeological District	Historic, Historic - Aboriginal, Prehistoric
Roosevelt	Schoolhouse Point (AR-03-12-06-13(TNF))	Historic
Rye	Rye Creek Ruin Platform Mound Complex Archeological District	Prehistoric
Sacaton	Ha-ak Va-ak Intaglio Site	Prehistoric
Safford	Marijilda Canyon Prehistoric Archeological District	Prehistoric
Safford	Oak Draw Archeological District	Prehistoric
Safford	Kearny Campsite and Trail	Historic, Military
Saint Johns	Lyman Lake Rock Art Site	Historic - Aboriginal, Prehistoric
Santa Rosa	Ventana Cave	Prehistoric
Scottsdale	Petroglyph Site AZ U 1:165	Prehistoric
Sedona	Loy Butte Pueblo	Prehistoric
Sedona	Sycamore Cliff Dwelling	Prehistoric
Sierra Vista	Garden Canyon Archeological Site	Prehistoric
Sierra Vista	Garden Canyon Petroglyphs	Prehistoric
Sonoita	Kentucky Camp Historic District	Historic
Sonoita	Upper Davidson Canyon Archeological District	Prehistoric
Springerville	Casa Malpais Site	Prehistoric
Springerville	Sherwood Ranch Pueblo	Prehistoric
St. David	Council Rocks Archaeological District	Prehistoric
St. John's	Lower Zuni River Archeological District	Historic, Historic - Aboriginal, Prehistoric
Three Points	Gunsight Mountain Archeological District	Historic, Prehistoric
Tubac	Barrio de Tubac Archeological District	Historic, Historic - Aboriginal
Tucson	Cocoraque Butte Archeological District	Prehistoric
Tucson	Rincon Mountain Foothills Archeological District	Historic - Aboriginal, Prehistoric
Tucson	Santa Ana del Chiquiburitac Mission Site	Historic - Aboriginal
Tucson	Site No. HD 13-11	Historic
Tucson	Site No. HD 13-13	Historic
Tucson	Site No. HD 13-4	Historic
Tucson	Site No. HD 4-8A	Historic
Tucson	Site No. HD 5-26	Historic
Tucson	Site No. HD 7-0A	Historic
Tucson	Site No. HD 7-13	Historic
Tucson	Site No. HD 9-28	Historic
Tucson	Site Nos. HD 12-4/12-8	Historic
Tucson	Sutherland Wash Archeological District	Historic, Historic - Aboriginal, Prehistoric
Tucson	Sutherland Wash Rock Art District	Prehistoric
Tucson	Tumamoc Hill Archeological District, The	Historic- Aboriginal, Prehistoric

Closest City	Site Name	Type of Site
Tucson	University Indian Ruin Archeological Research District	Historic- Aboriginal, Prehistoric
Tucson	Valencia Site (BB:13:15;BB:13:74)	Prehistoric
Tucson	Site Nos. HD 5-28/5-25	Historic
Tucson	Site Nos. HD 9-11/9-2	Historic
Whiteriver	Kinishba Ruins	Prehistoric
Winona	Winona	Prehistoric
Winslow	Nuvakwewtaqa	Historic - Aboriginal, Prehistoric
Winslow	Baird's Chevelon Steps	Historic - Aboriginal, Prehistoric
Winslow	Chevelon Ruin	Historic - Aboriginal, Prehistoric
Winslow	Homolovi Four (IV)	Prehistoric
Winslow	Homolovi I Ruin	Prehistoric
Winslow	Homolovi II	Prehistoric
Winslow	Homolovi III	Prehistoric
Yuma	San Ysidro Hacienda	Historic

Source: (NPS, 2014f)

3.1.11.6. Historic Context

In 1539, a monk named Marcos de Niza led a Spanish expedition into present-day Arizona in search of a city of gold called Cibola, though it appears he may have been preceded by another friar Juan de la Asuncion in 1538. Based on these reports and those of the end of the Cabeza de Vaca expedition in 1536, Francisco Vasquez de Coronado followed suit with an army in 1540, and while these expeditions failed to find great wealth, portions of what would become Arizona were explored by Europeans for the first time: including parts of the Grand Canyon and Colorado River (Planetary Science Institute, 2016). Spain claimed the region as a part of New Mexico, and it would remain in Spanish possession until Mexico gained independence in the 19th century (NPS, 2016l). Franciscan monks attempted to establish missions in Arizona during the 17th century, but were unsuccessful (University of Arizona, 2016b). In 1691, the first European permanent mission village was established in Tumacacori, by Father Francisco Eusebio Kino, a Jesuit priest who was instrumental in the early development of the region (NRHP, 2002).

In 1775, the city of Tucson was founded when a Spanish fort was established in the area in order to deal with ongoing conflicts with the Tohono O'odham and Pima Indians. Silver had been discovered decades earlier, and mining, ranching, and trade activities supporting the various missions in the territory had become the region's major economic drivers (City of Tucson, 2016). Many Arizona settlements were abandoned during the early 19th century due to continued Indian uprisings. In 1821, the region passed into Mexican control as they gained independence from Spain. As westward expansion was occurring within the U.S., trappers were beginning to venture into the region in search of beaver pelts (Arizona Edventures, 2015a).

In 1848, following the signing of the Treaty of Guadalupe Hidalgo, which ended the Mexican-American War, control of most of Arizona, along with all of what is now California, Nevada, and Utah, and parts of Colorado, Wyoming and New Mexico, passed to the U.S. In 1853, Arizona and part of New Mexico were expanded southward to their current boundaries through the Gadsden Purchase. Following that, American miners were attracted to old Spanish mines in the area and, in 1854, copper began to be extracted again. In 1862, during the Civil War, an attempt was made by the Confederacy to occupy New Mexico and Arizona; however, Confederate troops were rebuffed at the Battle of Glorieta Pass in New Mexico and ended these plans. In 1863, President Lincoln separated Arizona from New Mexico, officially creating the Arizona Territory. Gold and silver were still being mined during the late 19th century, but copper now dominated the territory's mining industry. In 1889, the capital was moved to Phoenix, which was soon "linked by rail to both northern and southern railroad lines, increasing the ability to move goods and people not only east and west, but also north and south" (Arizona Edventures, 2015a).

In 1911, the Roosevelt Dam was dedicated. The dam is located on the Salt River and is one of the first large land reclamation and irrigation projects in the southwest. On February 14, 1912, Arizona became the 48th state to join the Union. During World War I (WWI), Arizona's economy boomed, with industries such as copper mining and cotton farming growing, and in 1919, Grand Canyon National Park was created. During the Great Depression, copper prices fell, resulting in the closure of mines. Many Arizonans were forced to find work through New Deal work programs, with a significant number working as laborers constructing the Hoover Dam in Nevada. During World War II (WWII), the economy boomed, with military bases and training camps being established; two internment camps for Japanese-Americans were constructed as well. Following WWII, suburbanization has occurred on a large scale, particularly around Phoenix, which has resulted in the development of large areas of former Salt River Valley farmland. During the 20th century "Arizona became known for its five C's: copper, cattle, cotton, citrus, and climate" (Arizona Edventures, 2015b).

Arizona has 1,419 NRHP listed sites, as well as 45 NHLs (NPS, 2015j). Arizona contains one National Heritage Area (NHA), the Yuma Crossing NHA (NPS, 2015h). Figure 3.1.11-4 shows the location NHA and NRHP sites within Arizona.[139]

3.1.11.7. Architectural Context

Architecture in the area that now is comprised of Arizona dates back approximately 700 years, with the Casa Grande Ruins National Monument remaining from when the Sonoran people inhabited the area (NPS, 2015o). The Spanish arrived in the 16th century; however, no structures from the 16th century remain. The oldest Spanish structure in Arizona is the Mission San Xavier del Bac (founded in 1692, current church built from 1783 to 1797), which still functions as a church and contains many of its original furnishings (Mission San Xavier del Bac 2015).

Early European structures were primarily located in the south for missionary work and cattle ranching. Structures were built of adobe brick with wood beams used as structural members. These construction methods represent a combination of Spanish traditions with indigenous pueblo architecture. Ranches consisted of small collections of buildings arranged in a functional

[139] See Section 3.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

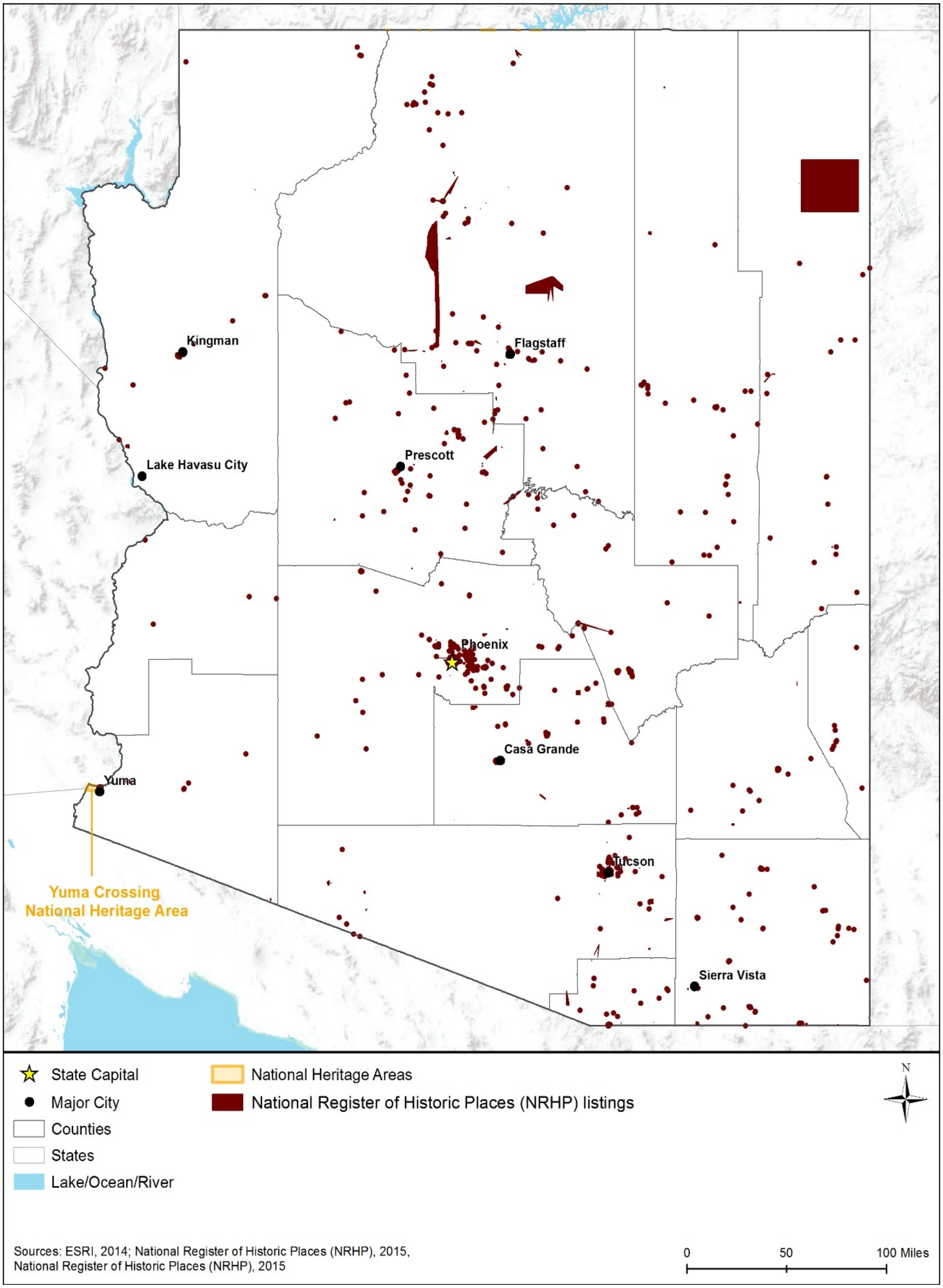

Figure 3.1.11-4: National Heritage Areas (NHA) and National Register of Historic Places (NRHP) Sites in Arizona

and defensive pattern. In the north, settled later by American settlers, structures were built of logs. While pueblo architecture existed in the north, the ample supply of timber allowed American settlers to rely on their own building methods primarily, rather than needing to adopt indigenous architectural designs. As settlement expanded, wealthy ranchers brought supplies from either back east or San Francisco to construct ornate houses. Windmills were common as well, with historic examples still remaining today (NRHP, 2002).

Prior to the arrival of the railroad, buildings in the south continued to be built of traditional adobe bricks, while those in the north relied on the supply of timber. Tucson was founded in the late 18th century when a fort was constructed to defend the nearby mission. Settlement developed around the fort and expanded outward. After the railroad arrived in 1880, building trends were permanently changed, as modern materials could be brought in to facilitate the construction of modern buildings. Downtown Tucson has a collection of historic commercial buildings, most of which are of the Two-Part Commercial Block type. These feature storefronts on the ground level, with private space on the upper floor. Two stories is most common; however, structures can be more than two stories in height as well (NRHP, 2016).

Popular architectural styles in southern Arizona include Sonoran style buildings constructed before the railroad arrived, which are generally one story and made of adobe brick and mud plaster. Following the arrival of the railroad, residential styles came to include Transformed Sonoran, Transitional (Territorial), American Territorial, and Queen Anne. Revival styles gained popularity around the turn of the 20th century and include Neoclassical Revival, California Mission Revival, Spanish Colonial Revival, Pueblo Revival, and Tudor Revival. Craftsman bungalows and Prairie houses were built during the interwar years. Art Deco and Streamline Moderne were built in the 1920s up until WWII, while the International style continues to be built today. After WWII, ranch houses appeared, as did Post-war Territorial, Post-war Pueblo, and Mid-Century Modern (Blenman-Elm Neighborhood Association and City of Tucson Historic Preservation Office 2015).

In the north, architectural styles include Gothic Revival, Classical Revival, and Renaissance Revival in mid-to-late 19th century (Adams Architecture & Planning, 1997). An example from this time period is Old Governor’s Mansion (1864), also known as Sharlot Hall (NPS, 2015s). Victorian Era styles became popular following that, and were in turn followed by the Classical Revival movement after the turn of the 20th century. Bungalows became popular after WWI, influenced by the growth of the style in California (Adams Architecture & Planning, 1997). As noted above, Frank Lloyd Wright’s Prairie style gained popularity during this period as well. After WWII, ranch houses were built in modern suburban neighborhoods. Examples of nonresidential architecture includes U.S. Post Office buildings constructed during the first half of the 20th century. These were built based on Classical Revival principles and range from one to three stories (NRHP, 1985). Another important cultural resource in Arizona is the historic Route 66, which linked Los Angeles and Chicago, while passing through Arizona. Route 66 was a major transportation artery and “is associated with the explosive growth of automobile tourism and with the general theme of transportation in America” (NRHP, 1989).

3.1.12. Air Quality

3.1.12.1. 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[140] 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)[141] or micrograms per cubic meter ($\mu g/m^3$) determined over various periods of time (averaging time).[142] This section discusses the existing air quality in Arizona. USEPA designates areas within the United States as attainment,[143] nonattainment,[144] maintenance,[145] or unclassifiable[146] 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.

Arizona has four separate and distinct air regulatory authorities – the ADEQ, the Pima County Department of Environmental Quality (PDEQ), the Pinal County Air Quality Control District (PCAQCD), and the Maricopa County Air Quality Department (MCAQD). The ADEQ is responsible for the whole state with exception of Pima, Pinal, and Maricopa counties; each of these counties have separate authorization as a distinct air regulatory authority. Each air regulatory authority has different air regulations, state implementation plan (SIP), and ambient air quality standards, as described in the following subsections.

3.1.12.2. Specific Regulatory Considerations Arizona Department of Environmental Quality (ADEQ)

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, oxides of nitrogen (NO_X), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_X). The NAAQS establish various standards, either primary[147] or secondary,[148] for each pollutant with varying averaging times.

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

141 Equivalent to 1 milligram per liter (mg/L).

142 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, 2015u).

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

144 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, 2015v).

145 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, 2015v).

146 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, 2015v).

147 Primary standard: The primary standard is set to provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly (USEPA, 2014a).

148 Secondary standards: The secondary standard is set to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings (USEPA, 2014a).

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. A description of the NAAQS is presented in Appendix E.

In addition to the NAAQS, there are standards for hazardous air pollutants (HAP), which are those typically associated with specific industrial processes such as chromium electroplating (hexavalent chromium), dry cleaning (perchloroethylene), and solvent degreasing (halogenated solvents) (USEPA, 2016d). 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. Appendix E presents a list of federally regulated HAPs.

Arizona does not maintain its own air quality standards, they adopted the federal NAAQS.

Title V Operating Permits/State Operating Permits

Arizona has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015h). Article 4 (Permit Requirements for New Major Sources and Major Modifications to Existing Major Sources) R18-2-401 of ADEQ regulation describes the applicability of Title V operating permits. Arizona requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 3.1.12-1). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 3.1.12-1: Major Air Pollutant Source Thresholds

Pollutant	Tons Per Year (TPY)
Any Pollutant	100
Single HAP	10
Total/Cumulative HAPs	25

Source: (USEPA, 2014b)

Exempt Activities

As defined in Arizona Administrative Code (AAC) R18-2-302 (Applicability, Registration, and Classes of Permits) ADEQ exempts stationary sources that “consist solely of a single categorically exempt activity plus any combination of trivial activities” (ADEQ, 2013a).

Categorically exempt activities are defined by ADEQ in R18-2-101.24 (Article 1 Definitions).[149] The following are categorically exempt activities:

- "Any combination of diesel-, natural gas- or gasoline-fired engines with cumulative power equal to or less than 145 horsepower.
- Natural gas-fired engines with cumulative power equal to or less than 155 horsepower.
- Gasoline-fired engines with cumulative power equal to or less than 200 horsepower.
- Any of the following emergency or stand-by engines used for less than 500 hours in each calendar year, provided the permittee keeps records documenting the hours of operation of the engines:
  - Any combination of diesel-, natural gas- or gasoline-fired emergency engines with cumulative power equal to or less than 2,500 horsepower.
  - Natural gas-fired emergency engines with cumulative power equal to or less than 2,700 horsepower.
  - Gasoline-fired emergency engines with cumulative power equal to or less than 3,700 horsepower.
- Any combination of boilers with a cumulative maximum design heat input capacity of less than 10 million Btu/hr." (ADEQ, 2013c)

Trivial activates are defined by the ADEQ in R18-2-101.144 (Article 1 Definitions) as "activities and emissions units, such as the following, that may be omitted from a permit or registration application:"

- Low-Emitting Combustion
  - Combustion emissions from propulsion of mobile sources;
  - Portable electrical generators that can be moved by hand from one location to another. "Moved by hand" means capable of being moved without the assistance of any motorized or non-motorized vehicle, conveyance, or device;
- Low- Or Non-Emitting Industrial Activities
  - …Brazing, soldering, and welding equipment, and cutting torches related to manufacturing and construction activities that do not result in emission of HAP metals. Brazing, soldering, and welding equipment, and cutting torches related to manufacturing and construction activities that emit HAP metals are insignificant activities based on size or production level thresholds …
  - …Hand-held applicator equipment for hot melt adhesives with no VOC in the adhesive formulation…" (ADEQ, 2013c)

Temporary Emissions Sources Permits

As defined in AAC R18-2-513 (Portable Sources Covered under a General Permit), the ADEQ permits temporary portable sources that are not solely based in a county that has their own regulations (PDEQ, PCAQCD, and MCAQD). When the portable source is moved to a different location one of the following must happen:

[149] Title 18, Environmental Quality, Chapter 2, Department of Environmental Quality Air Pollution Control is at http://apps.azsos.gov/public_services/Title_18/18-02.pdf.

- Submit a notification to the Director that the equipment is to be moved, or
- Obtain the proper permits form the correct regulatory authority if the equipment is to be moved to another regulating authority (i.e., PDEQ, PCAQCD, and MCAQD).

If the temporary emission source is not a portable source, a review of applicable stationary source requirements should be completed, or ADEQ Air Division should be contacted for additional assistance. (ADEQ, 2013c)

State Preconstruction Permits

The ADEQ does not have separate regulations for Preconstruction Permits. The operating permits detailed above include construction permit requirements and any SIP actions. Construction of any emission sources should review applicable construction and stationary permitting requirements, or contact ADEQ Air Division for additional assistance prior to constructing or modifying emission sources.

General Conformity

Established under Section 176(c)(4) of the CAA, the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality outlined in the SIP (USEPA, 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 (GPO, 2010).

The estimated pollutant emissions are compared to *de minimis*[150] levels. These tons per year (TPY) values are the minimum thresholds for which a conformity determination must be performed (see Table 3.1.12-2). No Arizona counties lie in the Ozone Transport Region (OTR).

Table 3.1.12-2: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO_X)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
Ozone (NO_X)	Maintenance	100
CO, SO_2, NO_2	All Nonattainment and Maintenance	100
PM_{10}	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
$PM_{2.5}$ (Direct Emissions)	All Nonattainment and Maintenance	100

[150] 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, 2016h)

Pollutant	Area Type	TPY
(SO_2) (NO_X (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))		
Lead	All Nonattainment and Maintenance	25

Source: (GPO, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 3.1.12-2, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 3.1.12-2, 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. To demonstrate conformity,[151] the agency would have to fulfill one or more of the following:

- Show any emissions increase is specifically identified and accounted for in the respective state's SIP;
- Receive acknowledgement from the state that any increase in emissions would not exceed the SIP emission budget;
- Receive acknowledgement from the state to revise the SIP and include emissions from the action;
- Show the emissions would be fully offset by implementing reductions from another source in the same area; and
- Conduct air quality modeling that demonstrates the emissions would not cause or contribute to new violations of the NAAQS, or increase the frequency or severity of any existing violations of the NAAQS (USEPA, 2010).

State Implementation Plan Requirements

The ADEQ SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. ADEQ's SIP is a conglomeration of separate actions taken for each of the pollutants. ADEQ's SIP actions are codified under 40 CFR Part 52 Subpart D. The SIP actions for the six criteria pollutants can be found on ADEQ's website. As noted above, the counties of Pima, Pinal, and Maricopa have separate authorization as distinct air regulatory authorities, and therefore have different SIPs than that of the ADEQ, as described in the following subsections.

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

3.1.12.3. Specific Regulatory Considerations Pima County Department of Environmental Quality (PDEQ)

National and State Ambient Air Quality Standards

In conjunction with the federal NAAQS, Pima County maintains its own air quality standards, the Pima Ambient Air Quality Standards (Pima AAQS). Table 3.1.12-3 presents an overview of the Pima AAQS as defined by PDEQ Code of Regulations, Chapter 2 part 257.

Table 3.1.12-3: Pima County Ambient Air Quality Standards (Pima AAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m³	ppm	μg/m³	ppm	
CO	8-hour	10,000	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	40,000	35	-	-	
Lead	3-month	1.5	-	Same as Primary		Maximum arithmetic mean averaged over a calendar quarter.
NO_2	Annual	100	0.053	Same as Primary		Annual arithmetic mean concentration
PM_{10}	24-hour	150	-	Same as Primary		24-hour average concentration
	Annual	50	-	Same as Primary		Annual arithmetic mean concentration
$PM_{2.5}$	Annual	15	-	Same as Primary		Annual arithmetic mean concentration
	24-hour	65	-	Same as Primary		98th percentile, averaged over 3 years
O_3	8-hour	-	0.08	Same as Primary		Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
SO_X	Annual	80	0.03	-	-	Annual arithmetic mean
	24-hour	365	0.14	-	-	Maximum 24-hour concentration not to be exceeded more than once per year
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year

Source: (PDEQ, 2015a)

Title V Operating Permits/State Operating Permits

Pima County has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015h). Chapter 17.12.140 (Applicability - Classes of permits) of Pima County Code of Ordinances describes the applicability of Title V operating permits. Pima requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 3.1.12-1) and lead at 5 TYP. The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Exempt Activities

The PDEQ has four types of permits:

- Class I Permits required for the following:
  - Major sources where the potential to emit (in the aggregate) for criteria pollutants meets or exceeds that as defined in Table 3.1.12-1,
  - Affected sources as defined in 40 CFR 63.2 (National Emission Standards for Hazardous Air Pollutants for Source Categories, Definitions) and
  - Sources that are listed in 40 CFR 70.3 (State Operating Permits, Applicably).
- Class II Permits are required for the following sources:
  - Sources subject to requirements of Section 111 of the CAA (Standards of Performance for New Stationary Sources) and
  - Sources subject to Section 112 of the CAA (National Emissions Standards for Hazardous Air Pollutants), unless they are only required to be permitted because of the requirements under Section 112(4) (Amendment of Spill Prevention, Control, and Countermeasure Plan by Regional Administrator.).
- Class III Permits are required for the following:
  - "Any source that emits, or has the potential to emit, without controls, significant quantities of regulated air pollutants. Stationary rotating machinery of greater than 325 brake horsepower.
  - Fuel-burning equipment which, at a location or property other than a one- or two-family residence, are fired at a sustained rate of more than one million BTUs per hour for more than an eight-hour period.
  - A person to begin actual construction of a source subject to Article IX of this Chapter.
  - A person to make a modification subject to Article IX of this Chapter to a source for which a permit has not been issued under this Article." (PDEQ, 2015a)
- General Permits are permits for a specific industry or source.

The PDEQ exempts specific sources as listed in 17.12.140.C, which are:

- Sources that are subject to the Standards of Performance for New Residential Wood Heaters,
- Sources only permitted because they are subject to 40 CFR 61.145 (Standard for Demolition and Renovation), and
- Agricultural equipment.

All other emission sources will require one of the four permits above. (PDEQ, 2015a)

Fugitive Dust Permits

The PDEQ requires a Fugitive Dust[152] Permit for activities that involve land disturbing activities. There are two types of permits, a multiple activity permit that can be obtained for projects that have more than one dust producing activity, as stated below for the single activity permit. A single activity permit which would include the following activities:

- Land Clearing or earthmoving over 1 acre in size;
- Trenching over 300 feet, including but not limited to utility installation and repair;
- Road construction over 50 feet in length; and
- Any blasting activities.
- Also exempt from obtaining a fugitive dust permit is trenching activities associated with landscaping irrigation line installation (as long as they do not disturb more than the first foot of topsoil), and trenching activities located under a road where a permit already exists. (PDEQ, 2015a)

If the project has a Class I, II, or III air quality permit that includes fugitive dust activities, the PDEQ does not require an additional Fugitive Dust Permit. (PDEQ, 2015a)

Temporary Emissions Sources Permits

The PDEQ does not have regulations for temporary emission source permitting. Any temporary emission sources should review applicable construction and stationary source requirements, or contact ADEQ Air Division for additional assistance.

Preconstruction Permits

The PDEQ does not have separate regulations for Preconstruction Permits. The operating permits detailed above have the construction permit built into them and include any SIP actions. Construction of any emission sources should review applicable construction and stationary permitting requirements, or contact PDEQ Air Division for additional assistance.

General Conformity

The PDEQ follows the federal General Conformity regulations and do not maintain their own. See section 3.1.12.2 for a general discussion of the Federal General Conformity laws.

State Implementation Plan Requirements

The PDEQ's SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. PDEQ's SIP is a conglomeration of separate actions taken for each of the pollutants. PDEQ's SIP actions are codified under 40 CFR Part 52 Subpart D. The SIP actions for all six criteria pollutants can be found on PDEQ website at http://webcms.pima.gov/

[152] Fugitive dust is "the particulate matter not collected by a capture system that is entrained in the ambient air and is caused from human, animal, and/or natural activities, such as, but not limited to, movement of soil, vehicles, equipment, blasting, and wind" (PCAQCD, 2015a).

3.1.12.4. Specific Regulatory Considerations Pinal County Air Quality Control District (PCAQCD)

State Ambient Air Quality Standards

In conjunction with the federal NAAQS, Pinal County maintains its own air quality standards, the Pinal Ambient Air Quality Standards (Pinal AAQS). Table 3.1.12-4 presents an overview of the Pinal AAQS as defined by Pinal County Air Quality Control District (PCAQCD) Code of Regulations, Chapter 2 part 257.

Table 3.1.12-4: Pinal County Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m³	ppm	μg/m³	ppm	
CO	8-hour	10,000	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	40,000	35	-	-	
Lead	3-month	1.5	-	Same as Primary		Maximum arithmetic mean averaged over a calendar quarter.
NO_2	Annual	100	0.053	Same as Primary		Annual arithmetic mean concentration
PM_{10}	24-hour	150	-	Same as Primary		24-hour average concentration
	Annual	50	-	Same as Primary		Annual arithmetic mean concentration
$PM_{2.5}$	Annual	15	-	Same as Primary		Annual mean, averaged over 3 years
	24-hour	65	-	Same as Primary		98th percentile, averaged over 3 years
O_3	8-hour	-	0.08	Same as Primary		Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
SO_X	Annual	80	0.03	-	-	Annual arithmetic mean
	24-hour	365	0.14	-	-	Maximum 24-hour concentration not to be exceeded more than once per year
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year

Source: (PCAQCD, 2015a)

Title V Operating Permits/State Operating Permits

PCAQCD has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015h). Article 3 (Permit Requirements for New Major Sources and Major Modifications to Existing Major Sources) of PCAQCD Code of Regulations describes the applicability of Title V operating permits. PCAQCD requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 3.1.12-1) and as listed in Table 3.1.12-5. The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Table 3.1.12-5: PCAQCD Major Air Pollutant Source Thresholds

Pollutant	TPY
CO – CO Serious	50
VOC – Ozone Serious	50
VOC – Ozone Severe	25
PM_{10} – PM_{10} Serious	70

Source: (PCAQCD, 2015a)

Exempt Activities

The PCAQCD has three permits, a Class I, Class II, and Class III. Permitting is dependent on the attainment status of the area in which the emissions source will be located. The PCAQCD exempts specific sources as listed in 3-1-040 (applicability and classes of permits), which are:

- Sources subject to the Standards of Performance for New Residential Wood Heaters,
- Sources that only need to be permitted because they are subject to 40 CFR 61.145 (Standard for Demolition and Renovation), and
- Agricultural equipment.

Discussions with the regulators indicate that smaller emergency generators will not meet the requirements of permitting, however they will have hours of operation restrictions and further discussions with generator details is needed. Discussion with the regulations for smaller limited use emergency generators and other emission sources will require one of the four permits above. (PCAQCD, 2015a)

Fugitive Dust Registration

The PCAQCD requires a Fugitive Dust Registration for activities that involve the following: "land stripping, earthmoving, blasting, trenching, road construction, grading, landscaping, stockpiling excavated materials, storing excavated materials, loading excavated materials, or any other activity associated with land development which results in a disturbed surface area or dust generating operations, shall all constitute affected activities if the disturbed surface area is greater than 0.1 acre" (PCAQCD, 2015a).

Temporary Emissions Sources Permits

The PCAQCD does not have regulations for temporary emission source permitting. Any temporary emission sources should review applicable construction and stationary source requirements, or contact PCAQCD Air Division for additional assistance.

Preconstruction Permits

The PCAQCD does not have separate regulations for Preconstruction Permits. The operating permits detailed above have the construction permit built into them and include any SIP actions.

Construction of any emission sources should review applicable construction and stationary permitting requirements, or contact PCAQCD Air Division for additional assistance.

General Conformity

The PCAQCD follows the federal General Conformity regulations and do not maintain their own. See section 3.1.12.2 for a general discussion of the Federal General Conformity laws.

State Implementation Plan Requirements

The PCAQCD's SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. PCAQCD's SIP is a conglomeration of separate actions taken for each of the pollutants. PCAQCD's SIP actions are codified under 40 CFR Part 52 Subpart D. The SIP actions for the six criteria pollutants can be found on the U.S. USEPA's website at https://www3.epa.gov/region09/air/actions/az.html

3.1.12.5. Specific Regulatory Considerations Maricopa County Air Quality Department (MCAQD)

State Ambient Air Quality Standards

In conjunction with the federal NAAQS, Maricopa County maintains its own air quality standards, the Maricopa Ambient Air Quality Standards (Maricopa AAQS). Table 3.1.12-6 presents an overview of the Maricopa AAQS as defined by Maricopa County Air Quality Department (MCAQD) regulations, Chapter 2 (Ambient Air Quality Standards) Article 1 (Air Quality Standards).

Table 3.1.12-6: Maricopa County Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	
CO	8-hour	10,000	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	40,000	35	-	-	
Lead	3-month	0.15	-	Same as Primary		Maximum arithmetic mean averaged over a calendar quarter.
NO_2	Annual	100	0.053	Same as Primary		Annual arithmetic mean concentration
PM_{10}	24-hour	150	-	Same as Primary		24-hour average concentration
	Annual	50	-	Same as Primary		Annual arithmetic mean concentration
$PM_{2.5}$	Annual	15	-	Same as Primary		Annual arithmetic mean concentration
	24-hour	65	-	Same as Primary		98th percentile, averaged over 3 years
O_3	8-hour	-	0.08	Same as Primary		Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		μg/m³	ppm	μg/m³	ppm	
SO_X	Annual	80	0.03	-	-	Annual arithmetic mean
	24-hour	365	0.14	-	-	Maximum 24-hour concentration not to be exceeded more than once per year
	3-hour	-	-	1,300	0.5	Not to be exceeded more than once per year

Source: (Maricopa County, 2006)

Title V Operating Permits/State Operating Permits

MCAQD has authorization to issue CAA Title V operating permits on behalf of the USEPA, as outlined in 40 CFR 70. The Title V program refers to Title V of the CAA that governs permitting requirements for major industrial air pollution sources and consolidates all CAA requirements for the facility into one permit (USEPA, 2015h). The overall goal of the Title V program is to "reduce violations of air pollution laws and improve enforcement of those laws" (USEPA, 2015h). Regulation II – Permits and Fees (Rule 245) of MCAQD Code of Regulations describes the applicability of Title V operating permits. MCAQD requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 3.1.12-1). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

Exempt Activities

The MCAQD issues five types of permits - Title V operating permits, Non-Title V Permits, General Permits, Dust Control Permits, and Permits to Burn. The type of permit needed for an emission source is dependent on the attainment status of the area where the emissions source will be located. The MCAQD exempts specific sources as listed in Regulation II – Permits and Fees, Rule 200, Section 308 (Exemptions), unless the source meets requirements of Section 301 (Permits Required), Section 302 (Title V Permit), and Section 303 (Non-Title V Permit). Sources are exempt if they meet one of the following:

- Sources are subject to the Standards of Performance for New Residential Wood Heaters,
- Sources that only need to be permitted because they are subject to 40 CFR 61.145 (Standard for Demolition and Renovation), and
- Agricultural equipment.

All other sources will require one of the above permits. (Maricopa County, 2008)

Fugitive Dust Permits

The MCAQD requires a Fugitive Dust Permit prior to commencing work. A Fugitive Dust Permit is required for any dust-generating activity that disturbs a surface area greater than 0.1 acre or more, including but not limited to projects that have a Title V, Non-Title V or General Permit air permit. (Maricopa County, 2010)

Temporary Emissions Sources Permits

The MCAQD permits temporary portable internal combustion engines under Regulation II, Rule 200 Section 303 (Non-Title V Permit). "Portable internal combustion engines used on a temporary basis of no more than 30 days per calendar year at one facility" require a Non-Title V Permit. (Maricopa County, 2008)

State Preconstruction Permits

The MCAQD does not have separate regulations for Preconstruction Permits. The operating permits detailed above have the construction permit built into them and include any SIP actions. Construction of any emission sources should review applicable construction and stationary permitting requirements, or contact MCAQD Air Division for additional assistance.

General Conformity

The MCAQD follows the federal General Conformity regulations and do not maintain their own. See section 3.1.12.2 for a general discussion of the Federal General Conformity laws.

State Implementation Plan Requirements

The MCAQD's SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. MCAQD's SIP is a conglomeration of separate actions taken for each of the pollutants. MCAQD's SIP actions are codified under 40 CFR Part 52 Subpart D. The SIP actions for the six criteria pollutants can be found on the MCAQD's website.

3.1.12.6. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 3.1.12-1 and Table 3.1.12-7 present the nonattainment areas in Arizona as of January 30, 2015. Table 3.1.12-7 contains a list of the counties and their respective current nonattainment status of each criteria pollutant. The year(s) listed in the table for each pollutant indicate the date(s) when USEPA promulgated an ambient air quality standard for that pollutant. Note certain pollutants have more than one standard in effect (e.g., $PM_{2.5}$, O_3, and SO_2). Unlike Table 3.1.12-7, Figure 3.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

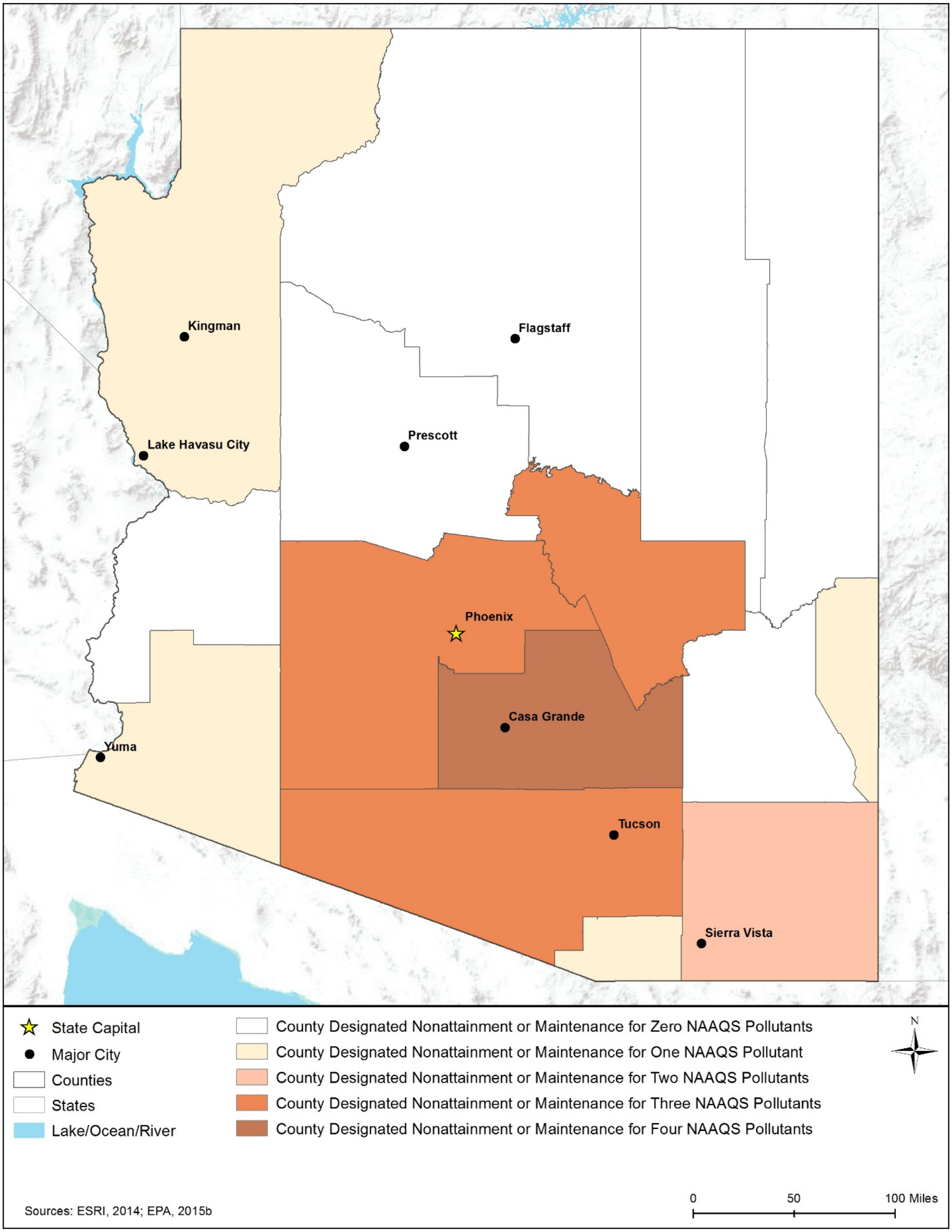


Figure 3.1.12-1: Nonattainment and Maintenance Counties in Arizona

Table 3.1.12-7: Arizona 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	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Cochise					X-4					M	
Gila (Hayden, AZ)			X-6		X-4						X-6
Gila (Miami, AZ)					X-4						X-6
Gila (Payson, AZ)					M						
Gila (Miami (Gila County), AZ)										M	
Greenlee										M	
Maricopa	M				X-3			M	X-5		
Mohave					M						
Pima	M				X-4					M	
Pinal (Phoenix-Mesa, AZ)								M	X-5		
Pinal (Hayden, AZ)			X-6		X-4						X-6
Pinal (Phoenix, AZ)					X-3						
Pinal (West Pinal, AZ)					X-4						
Pinal (West Central Pinal, AZ)							X-4				
Pinal (Hayden (Pinal County), AZ)										X-6	
Pinal (San Manuel (Pinal County), AZ)										M	
Santa Cruz					X-4		X-4				
Yuma					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

Air Quality Monitoring and Reporting

Arizona has four separate and distinct air regulatory authorities – the Arizona Department of Environmental Quality (ADEQ), the Pima County Department of Environmental Quality (PDEQ), the Pinal County Air Quality Control District (PCAQCD), and the Maricopa County

Air Quality Department (MCAQD). The ADEQ is responsible for the whole state with exception of Pima, Pinal, and Maricopa Counties. Each air regulatory authority submits annual air quality reports to the USEPA. Across Arizona both PM and O_3 are main pollutants of concern and are reported on each agencies website to inform the public.

ADEQ measures air pollutants at 42 sites across the state (with exception of Pima, Pinal, and Maricopa counties) as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network (ADEQ, 2015m). Annual ADEQ Ambient Air Quality Reports are prepared, containing pollutant data summarized by the county. ADEQ reports real-time pollution levels of PM_{10} on the AirNOW[153] website at http://www.airnow.gov/ to inform the public, as PM_{10} is the main pollutant of concern in Arizona (ADEQ, 2015n).

- Throughout 2014, O3 measurements exceeded the federal standard four times at JLG Supersite (Maricopa County), Yuma Supersite (Yuma County), and Prescott College AQD (Yavapai County). SO2 measurements exceeded the federal standard 84 times at Hayden Old Jail (Gila County) and 35 times at Miami Ridgeline (Gila County).
- PM_{10} measurements exceeded the federal standard nine times at Yuma Supersite (Yuma County), and three times at Douglas Red Cross and at Paul Spur Chemical Lime Plant (Cochise County) in 2014.
- There were three exceedances of $PM_{2.5}$ measurements at Nogales Post Office in 2014. The three-year maximum three-month rolling average of PB measurements exceeded the federal standard at Globe Highway (Gila County). (ADEQ, 2015n)

PDEQ measures air pollutants at 17 sites across Pima County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. Annual Pima County Ambient Air Quality Reports are prepared, containing pollutant data summarized by the county. PDEQ reports real-time pollution levels of PM_{10} on their website to inform the public, as PM_{10} is the main pollutant of concern in Arizona.

- Throughout 2014, PM_{10} exceeded at three locations, Orange Grove, Geronimo, and Green Valley. No other criteria pollutants exceeded federal standards. (PDEQ, 2015b)

PCAQCD measures air pollutants at 13 sites across Pinal County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. Annual Pinal County Ambient Air Quality Reports are prepared, containing pollutant data summarized by the county. PCAQCD reports real-time pollution levels of O_3 and PM_{10} on the AirNOW website at http://www.airnow.gov/ to inform the public, as O_3 and PM_{10} are the main pollutants of concern in Pinal County. (PCAQCD, 2015b)

- Throughout 2014, O_3 levels were exceeded three times, one time at Casa Grande Airport, Pinal Air Park, and Queen Valley.
- There were 86 exceedances for 24 hour PM_{10}, 63 times at Cowtown Road (TEOM (Tapered Element Oscillating Microbalance)), five times at Casa Grande Downtown (TEOM) and

[153] AirNow is a government website that posts daily Air Quality Index for more than 400 cities.

Combs School (TEOM), nine times at Stanfield County Complex (TEOM), two times at City of Maricopa County Complex (TEOM), and one time at Pinal Air Park (TEOM) and Pinal County Housing (TEOM). (PCAQCD, 2015b)

MCAQD measures air pollutants at 23 sites across Maricopa County as part of the National Air Monitoring Stations Network and the County Air Monitoring Stations Network. Annual Maricopa County Ambient Air Quality Reports are prepared, containing pollutant data summarized by the county. MCAQD reports real-time pollution levels of PM_{10} on their website at http://alert.fcd.maricopa.gov/alert/Google/v3/air.html to inform the public, as PM_{10} is the main pollutant of concern in Maricopa County.

- Throughout 2014, there were 42 exceedances for O_3, six exceedances at Mesa, North Phoenix, and Pinnacle Peak, four exceedances at West Phoenix and Falcon Field, three exceedances at Humboldt Mt., two exceedances at Blue Point, Cave Creek, Glendale, Rio Verde, and South Phoenix, and once at Central Phoenix, South Scotts., and Tempe.
- There were seven PM_{10} exceedances in 2014, three exceedances at South Phoenix, two exceedances at Buckeye, Durango Complex, Greenwood, Higley, South Scottsdale, and West Phoenix, and one exceedance at Central Phoenix, Dysart, Glendale, Mesa, North Phoenix Tempe, West 43rd Avenue, West Chandler and Zuni Hills.
- There were nine $PM_{2.5}$ exceedances in 2014, three times at West Phoenix and once at South Phoenix, Durango Complex, Glendale, Mesa, Tempe, and JLG Supersite (ADEQ). (MCAQD, 2015)

Air Quality Control Regions

USEPA classified all land in the United States as a Class I, Class II, or Class III Federal Air Quality Control Region (AQCR) (42 U.S.C. 7470). Class I areas include international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size. Class I areas cannot be re-designated as Class II or Class III and are intended to maintain pristine air quality. Although USEPA developed the standards for a Class III AQCR, to date they have not actually classified any area as Class III. Therefore, any area that is not classified as a Class I area is, by default, automatically designated as a Class II AQCR (42 U.S.C. 7470).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers[154] of a Class I area. “The USEPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

[154] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 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 50 kilometers[155] (the normal useful range of USEPA-approved Gaussian plume models" (USEPA, 1992).

Arizona contains 12 Federal Class I areas and the rest of the land within the state is classified as Class II (USEPA, 2012b). If an action is considered a major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (USEPA, 1992). Utah has 3 Class I areas and Colorado, California, and New Mexico have one Class I area where the 100-kilometer buffer intersects a few Arizona counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. Figure 3.1.12-2 provides a map of Arizona highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 3.1.12-2 correspond to the numbers and Class I areas listed in Table 3.1.12-8.

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

Table 3.1.12-8: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Chiricahua NM Wilderness-Not Studied	9,440	AZ
	Chiricahua NM Wilderness-Designated Wilderness		AZ
	Chiricahua NM Wilderness-Designated Wilderness		AZ
	Chiricahua NM Wilderness-Designated Wilderness		AZ
2	Grand Canyon NP	1,176,913	AZ
3	Saguaro Wilderness	71,400	AZ
	Saguaro Wilderness		AZ
	Saguaro Wilderness		AZ
	Saguaro Wilderness		AZ
	Saguaro Wilderness		AZ
4	Petrified Forest NP	93,493	AZ
5	Sycamore Canyon Wilderness	47,757	AZ
6	Superstition Wilderness	124,117	AZ
7	Sierra Ancha Wilderness	20,850	AZ
8	Pine Mountain Wilderness	20,061	AZ
9	Mount Baldy Wilderness	6,975	AZ
10	Mazatzal Wilderness	205,137	AZ
11	Galiuro Wilderness	52,717	AZ
12	Chiricahua Wilderness	18,000	AZ
13	Zion NP	142,462	UT
14	Capitol Reef NP	221,896	UT
15	Bryce Canyon NP	35,832	UT
16	Joshua Tree Wilderness	429,690	CA
17	Mesa Verde NP	51,488	CO
18	Gila Wilderness	433,690	NM

Source: (USEPA, 2012b)

[a] The numbers correspond to the shaded regions in Figure 3.1.12-2.

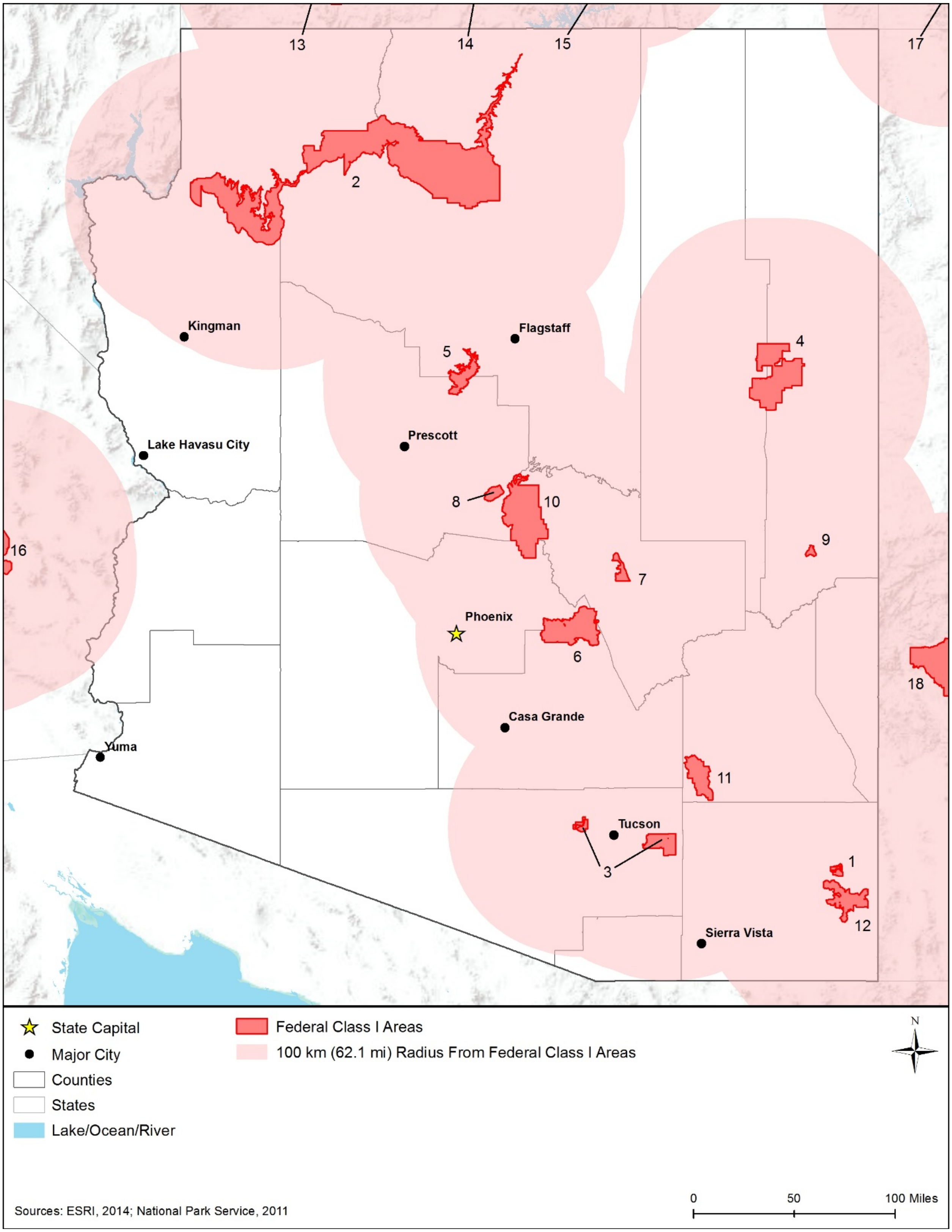


Figure 3.1.12-2: Federal Class I Areas With Implications for Arizona

3.1.13. Noise

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

3.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012a). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”) (OSHA, 2016a). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015f). The A-weighted scale, denoted as dBA, approximates the range of human hearing by filtering out lower frequency noises, which are not as damaging as the higher frequencies. The dBA scale is used in most noise ordinances and standards (OSHA, 2016a).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (FTA, 2006):

- The total sound energy radiated by a source, usually reported as a sound power level.
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (SPL) (the frequency characteristics and SPL combine to determine the loudness of a sound at a particular location).
- The duration of a sound.
- The changes in frequency characteristics or pressure levels through time.

Figure 3.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.

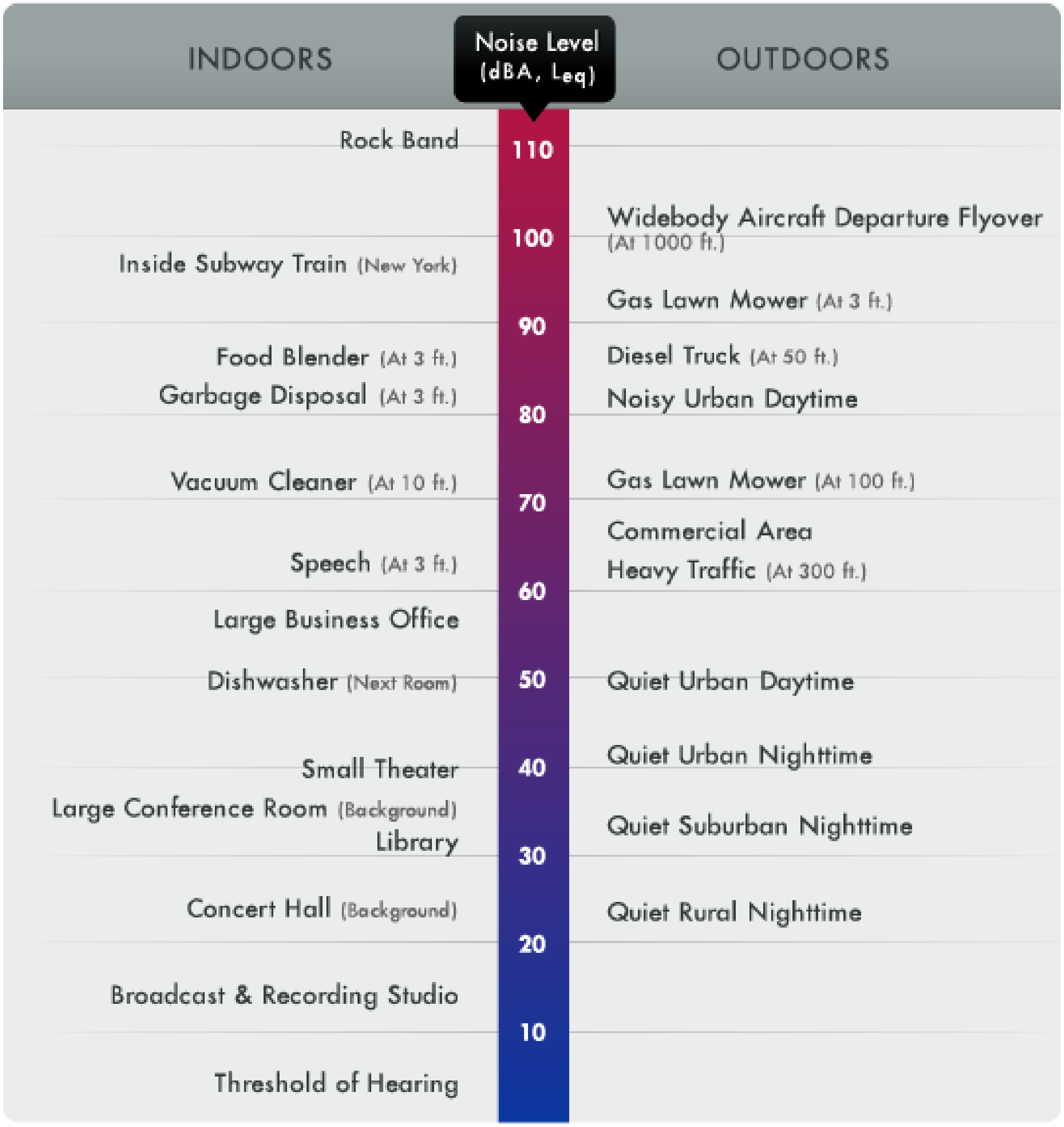


Figure 3.1.13-1: Sound Levels of Typical Sounds

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

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (for example: 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (for example: 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (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 depending on whether the environment is urban, suburban, or rural.

3.1.13.2. 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.

Arizona does not have any state-wide noise regulations. 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 Phoenix, Tucson, or Flagstaff, 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).

3.1.13.3. Environmental Setting: Ambient Noise

The range and level of ambient noise in Arizona varies widely based on the area and environment of the area. The population of Arizona can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 3.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Arizona may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Arizona. As such, this section describes the areas where the population of Arizona 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) (DOI, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Phoenix (and its neighboring boroughs and cities), Tucson, and Flagstaff.
- **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 Arizona, Phoenix Sky Harbor International Airport (PHX) and Tucson International Airport (TUS) have more than 21,000,000 annual operations combined (FAA, 2015j). These operations result in increased ambient noise levels in the surrounding communities. See Section 3.1.1, Infrastructure, and Figure 3.1.7-7 for more information about airports in the state.

- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (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 3.1.1, Infrastructure, and Figure 3.1.1-1 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). Arizona has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors include lines that extend mainly from Phoenix to other cities in Arizona, California, and New Mexico, such as the Union Pacific Railroad. There are also a number of other rail corridors that join these major rail lines and connect with other cities (AZDOT, 2011b). See Section 3.1.1, Infrastructure, and Figure 3.1.1-1 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). Arizona has 22 units of the National Park Service and 10 National Natural Landmarks (National Parks Conservation Association, 2015) (NPS, 2015c). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 3.1.8, Visual Resources, for more information about national and state parks for Arizona.

3.1.13.4. Sensitive Noise Receptors

Noise-sensitive receptors include residences, schools, medical facilities, places of worship, libraries, churches, nursing homes, concert halls, playgrounds, and parks. Sensitive noise receptors are typically areas where the intrusion of noise can disrupt the use of the environment. A quiet urban area usually has a typical noise level in the daytime of 50 dBA, and 40 dBA during the evening. Noise levels in remote wilderness and rural nighttime areas are usually 30 dBA (BLM, 2014a). Most cities and towns in Arizona have at least one school, church, or park, in addition to likely having other noise-sensitive receptors. There are most likely thousands of sensitive receptors in Arizona.

3.1.14. Climate Change

3.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in million metric tons (MMT) CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

The IPCC reports that "global concentrations of these four GHGs have increased significantly since 1750" with "Atmospheric concentrations of CO_2 increased from 280 parts per million (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 3.2.14, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts:
1) temperature; 2) precipitation/drought; and 3) severe weather events.

3.1.14.2. 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. In 2005 Governor Janet Napolitano signed EO 2005-2, establishing a Climate Change Advisory Group charged with preparing a GHG inventory and Climate Change Action Plan for Arizona. The final report was published in 2006, but the recommendations were not adopted by the state legislature or incorporated into any regulations or executive orders.

3.1.14.3. Arizona Greenhouse Gas Emissions

Estimates of Arizona's total GHG emissions vary. The Department of Energy's Energy Information Agency (EIA) collects and disseminates national-level data on emissions of CO_2 from fossil fuels by state. In addition, EIA maintains data on other GHGs such as CH_4 and nitrous oxide (NOx), but these are not broken down by state (EIA, 2015c). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2016e). Individual states have developed their own GHG inventories and these are updated with different frequencies and trace GHG in different ways.

For the purposes of this PEIS, the EIA data on CO_2 emissions from fossil fuels will be 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 will be described and cited.

According to the EIA, Arizona emitted a total of 93.8 MMT of CO_2 in 2013. Arizona's CO_2 emissions profile is dominated by the electric power sector which emitted 58.3 percent of the total, and accounts for almost all of the coal-related emissions (EIA, 2015d). The transportation sector emits 31.8 percent of total emissions, accounting for almost all of the petroleum products (Table 3.1.14-1) (EIA, 2015d) (EIA, 2015e) (EIA, 2015f) (EIA, 2016a). Annual emissions between 1980 and 2013 are displayed in Figure 3.1.14.2-1. Between 1980 and 2013, Arizona's CO_2 emissions increased to a maximum of 100.8 MMT in 2008. Since 2008, emissions from coal and petroleum products decreased while emissions from natural gas accelerated. Emissions from 2008 declined to 89.9 MMT in 2012. In 2013 emissions increased slightly, almost entirely due to increases in emissions from coal in the electric power sector (EIA, 2016). Arizona was ranked 21st among the states for CO_2 emissions in 2013 and was ranked 31st for per capita CO_2 emissions (EIA, 2015e) (EIA, 2016b).

Table 3.1.14-1: Arizona CO_2 Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	43.0	Residential	2.4
Petroleum Products	32.8	Commercial	2.4
Natural Gas	18.1	Industrial	4.5
		Transportation	29.8
		Electric Power	54.7
TOTAL	**93.8**	**TOTAL**	**93.8**

Source: (EIA, 2016a)

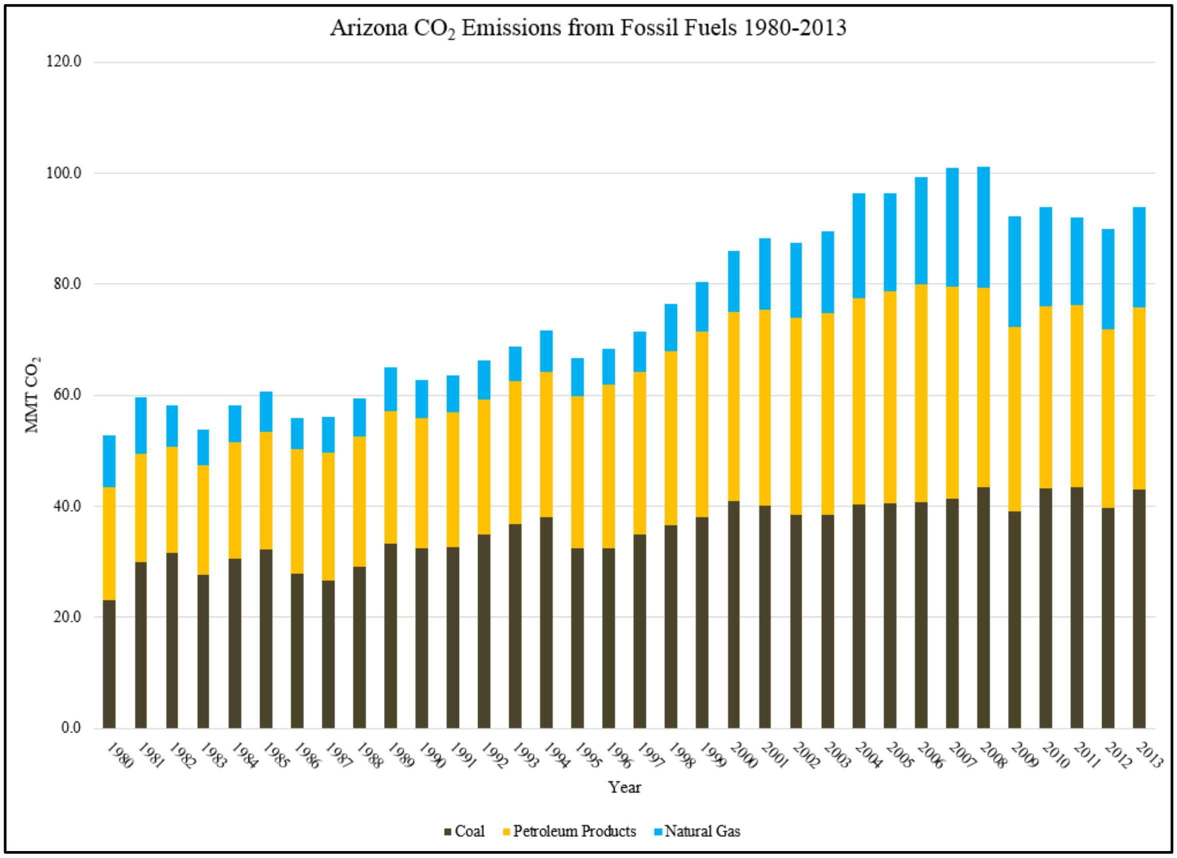


Figure 3.1.14-1: Arizona CO_2 Emissions by Source 1980-2013

Source: (EIA, 2016a)

The majority of Arizona's GHG emissions is CO_2. These emissions are the result of fossil fuel combustion for producing energy, mostly petroleum products from electric power generating facilities and coal-fired power plants. Other major GHGs emitted in Arizona are CH_4, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF_6), and perfluorocarbons (Center for Climate Strategies, 2005).

Arizona commissioned the Center for Climate Strategies to prepare an inventory of Arizona's GHG emissions, which was most recently updated in June 2005. In 1990 Arizona's annual net GHG emissions were 59.3 MMT CO_2e. These increased by 2000 by 39 percent to 82.3 MMt CO_2e. The report forecasted Arizona's GHG emissions to increase by 159 percent from their 1990 levels by 2020 – the fastest growth rate of any state with a climate action plan at the time. The report estimates that the transportation and electricity sectors will account for about 88 percent of Arizona's projected net GHG emissions (Center for Climate Strategies, 2005).

Arizona consumes a majority of its petroleum from the transportation sector. Transportation emissions have continuously risen 3 percent annually since 1990. In the 1990s, vehicles powered by gasoline were responsible for 65 percent of transportation- related GHG emissions while diesel contributed 20 percent. The remaining emissions were a result of air travel, natural gas, and LPG vehicles (Center for Climate Strategies, 2005).

The residential sector continues to contribute to a large percentage of GHG emissions in Arizona. In Arizona, electricity is a widely used source of for power and air conditioning during the hot summers. Electricity is also used to pump drinking and irrigation water around the state from the Colorado River. Emissions from the residential sector have grown annually but a slight decline was seen in the 1990s when the use of natural gas generation started to increase and displace coal (Center for Climate Strategies, 2005) (EIA, 2015h).

It is likely that electricity and transportation emissions will continue to have the largest impact on greenhouse gas emissions. Arizona is taking steps to help decrease emissions as it expands its hydroelectric, solar and wind energy resources across the state but overall, emissions will likely continue to increase (Center for Climate Strategies, 2005) (EIA, 2015h).

3.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NWS, 2011a). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2011a).

The majority of Arizona falls into the climate group B (see Figure 3.1.14-1). 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). Although the majority of Arizona falls into climate group B, portions of east central and southeastern Arizona are classified as 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, C climate groups experience regularly occurring thunderstorms. Arizona has five sub-climate category, which are described below in the following paragraphs (NWS, 2011a) (NWS, 2011b).

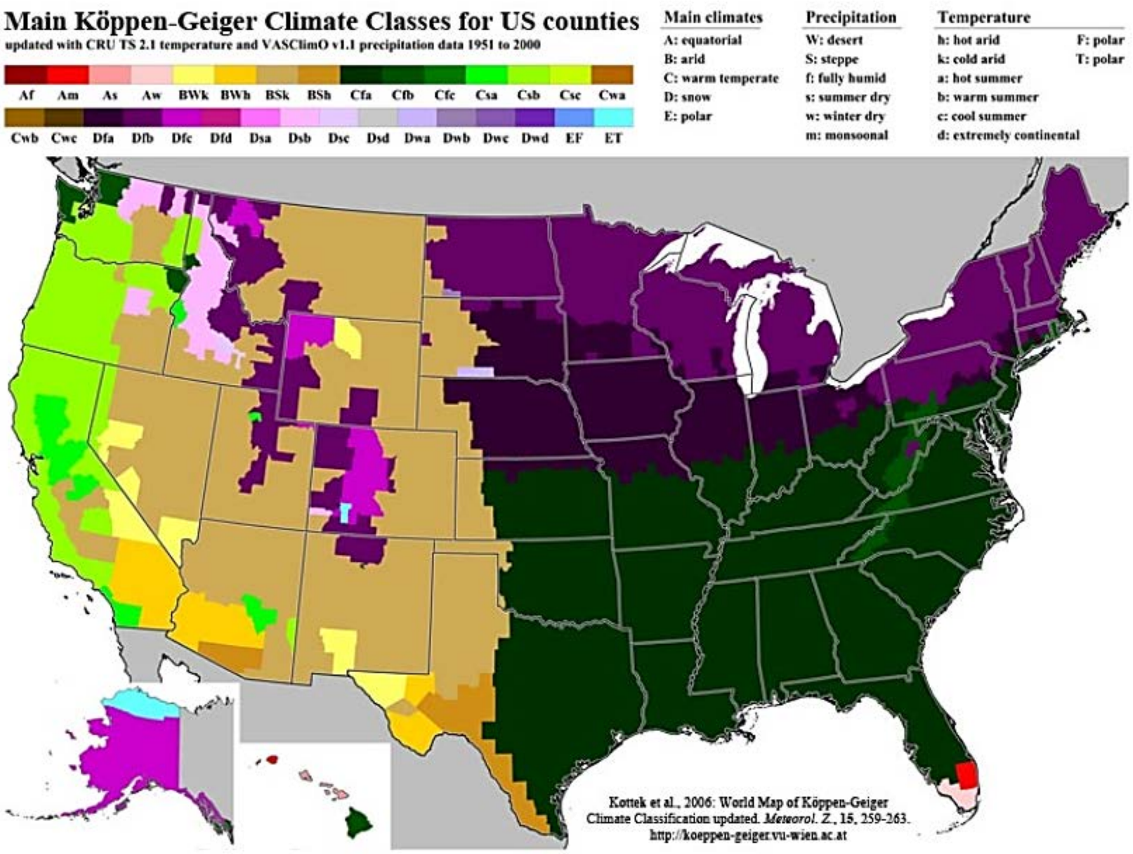


Figure 3.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Bsk – The Köppen-Geiger climate classification system classifies the majority of Arizona as Bsk. Climates classified as Bsk, are mid-latitude and dry. "Evaporation exceed precipitation on average but is less than potential evaporation" (NWS, 2011b). Average temperatures in Bsk climate zones are less than 64 °F (NWS, 2011a) (NWS, 2011b).

BWh – The Köppen-Geiger climate classification system classifies portions of south central and southwestern Arizona 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 °F. BWh climates are too dry to support most plant life. Frost in BWh climates is absent or infrequent. (GLOBE SCRC, 2015) (NWS, 2011a) (NWS, 2011b)

BSh – The Köppen-Geiger climate classification system classifies portions of southern and southwestern Arizona 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, 2011b)

Csa – The Köppen-Geiger climate classification system classifies portions of central and east central Arizona as Csa. Climates classified as Csa are Mediterranean climates, with mild temperatures and dry, hot summers. The warmest months in Csa climates are greater than 72 °F. A minimum of four months out of the year experience average temperatures that are greater than 50 °F. Csa climates experience frost during winter months and "at least three times as much precipitation during [the] wettest winter months as in the driest summer month" (NWS, 2011b). The coldest month in Csa climates is warmer than 26.6 °F but cooler than 64 °F. Summers in Csa climates are dry and mild. (GLOBE SCRC, 2015) (NWS, 2011a) (NWS, 2011b)

Csb – The Köppen-Geiger climate classification system classifies areas of western Nevada as Csb. Climates classified as Csb are Mediterranean climates, with mild temperatures and cool, dry summers. In Csb climates, the coldest months are warmer than 26 °F but cooler than 64 °F, with at least four months averaging temperatures greater than 50 °F (GLOBE SCRC, 2015) (NWS, 2011b). Summers in Csb climates are dry and mild (GLOBE SCRC, 2015). Winters in Csb climates typically have high levels of frost, with "at least three times as much precipitation during [the] wettest winter months as in the driest summer month" (NWS, 2011b). Csb climates are typically found on western sides of continents and near the coast (GLOBE SCRC, 2015). (NWS, 2011a) (NWS, 2011b)

This section discusses the current state of Arizona's climate with regard to air temperature, precipitation, and extreme weather events (e.g., flooding, drought, and thunderstorms) in the state's five climate regions, Bsk, BWb, BSb, Csa, and Csb.

Air Temperature

In low-lying, desert areas of southwestern Arizona, average winter temperatures are approximately 40 °F at night and 60 to 70 °F during the day. During the summer, average temperatures range from 70 to 80 °F at night and to over 110 °F during the day. The highest temperatures in Arizona typically occur along the lower Colorado River border between Arizona and California, frequently reaching or exceeding 115 °F. During winter months in northern areas of the state, average temperatures drop to below freezing at night and rise to approximately 50 °F during the day. The highest temperature to occur in Arizona was on June 29, 1994 with a record of 128 °F in Lake Havasu City (SCEC, 2015). The lowest temperature to occur in Arizona was on January 7, 1971 with a record of negative 40 °F in Hawley Lake (SCEC, 2015). In Phoenix, the capital of Arizona, temperatures between 1961 and 1990 display a mean annual temperature of 72.6 °F (Arizona State Climate Office, 2015a). Between 1971 and 2000, the mean annual temperature increased slightly to 74.2 °F (Arizona State Climate Office, 2015a). (NOAA, 2015b) (NOAA, 2015c) (Selover, 2015)

The decade 2001-2010 was the warmest in the 110-year instrumental historical record keeping, with temperatures almost 2 °F higher than historic averages, which included fewer cold air outbreaks and more heat waves. Summertime heat waves are projected to become longer and hotter, whereas the trend of decreasing wintertime cold air outbreaks is projected to continue. These changes will directly affect urban public health and will also have direct impacts on crop yields. (USGCRP, 2014a)

Precipitation

Southwestern and northeastern Arizona are considered arid, with an annual rainfall between three and 11 inches. Yuma, located in the southwest corner of the state, receives approximately three inches per year, while areas along the Mogollon Rim receive between 29 and 45 inches of "precipitation each year, with significant snowfall in the winter, particularly during El Nino years" (Selover, 2015). Precipitation in Arizona falls during two seasons. During winter months, "storms systems and associated cold fronts move down from the northern Pacific Ocean and Pacific Northwest regions and sweep across the western United States" (Selover, 2015). During summer months, westerly winds shift to southerly and bring "moisture northward from Mexico and the Gulf of California to occasionally produce severe thunderstorms, heavy rainfall, and widespread flash flooding" (Selover, 2015). In southern Arizona, the majority of precipitation each year falls during the summer months, while northern Arizona receives the majority of its precipitation during winter months. Winter storms rarely result in snowfall in southern Arizona, but in higher elevations, such as Mount Lemmon in Tucson, snowfall is more frequent. In central Arizona, approximately half of the annual precipitation is attributed to the state's monsoon activity. In southern Arizona, approximately two-thirds to three-fourths of annual precipitation is attributed to monsoon activity (Arizona State Climate Office, 2015b) (Selover, 2015).

"In general, the precipitation regime statewide is comprised of long periods of dry weather punctuated by flash flooding" (Selover, 2015). On October 18, 2005 and March 11, 2006, Phoenix experienced the longest stretch of days with no measureable precipitation, 143 days. The greatest 24-hour precipitation accumulation to occur in Arizona was on September 4 and 5, 1970 with a total of 11.4 inches in Workman Creek (SCEC, 2015). The greatest 24-hour snowfall accumulation to occur in Arizona was on December 14, 1967 and February 25, 1987 with a total of 38 inches in Heber (Black Mesa) Ranger Station and Alpine 18 SW, respectively (SCEC, 2015) (Arizona State Climate Office, 2015c).

Severe Weather Events

Arizona is not a coastal state and is located well inland from any coastline, therefore hurricanes and coastal storms do not affect Arizona on a regular or frequent basis. However, on occasion the remnants of tropical storms from the Baja coast can move inland and cause significant damage. The most notable examples include Tropical Storm Norma (1970), Tropical Storm Joanne (1972), Tropical Storm Heather (1977), Tropical Storm Octave (1983), and Hurricane Norbert (2014). In each case, rainfall was intense and prolonged, washing out roads, downing powerlines (and even aircraft in the case of Octave), isolating communities, and destroying crops and topsoil (NOAA, 2015d). Hurricane Norbert caused the second-highest single day of rainfall ever recorded in Arizona, and extensive flash flooding around Phoenix (NOAA, 2014).

Severe flooding can occur throughout Arizona due to remnants of tropical storms, but also from summer storms unrelated to tropical depressions, as well as winter storms, and their interaction with burn scars (land exposed after a wildfire which absorbs less rainfall), dry wash (when the land is extremely dry and rainfall cannot soak in), and snow melt (NOAA, 2015e). Flash flooding occurs most frequently during Arizona's monsoon, which constitutes the northernmost extent of the North American Monsoon. The monsoon season, during which the dry westerly winds that persist through fall, winter and spring shift to moist southerly winds, bringing thunderstorm activity into Arizona, lasts from approximately mid-June to mid-September (Comrie, 1997). The monsoon activity accounts for roughly half the annual precipitation in central Arizona, and two-thirds to three-fourths of the annual precipitation in southern Arizona. The short-lived, intense thunderstorms often result in flash flooding in steep terrain, as well as urban flooding through low-lying roads and normally dry washes (Arizona State Climate Office, 2015d).

Winter storms in Arizona occur frequently and include heavy snowfall, freezing rain, and sleet. Heavy precipitation associated with winter storms has the potential to collapse roofs, topple trees and utility poles, and cause road closures due to rapid accumulation of ice or snow, as well as serious and extensive traffic accidents. Since 2000, at least 81 winter storms were identified in Arizona, with 13 fatalities and 20 injuries reported, mostly associated with traffic accidents. These storms can have secondary effects such as flash flooding when all the accumulated snow melts quickly (AZDEMA, 2013b).

3.1.15. Human Health and Safety

3.1.15.1. 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) radiation, vehicle traffic, or the transportation of hazardous materials and wastes. RF radiation is discussed in Section 2.4, RF Emissions. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 3.1.1, Infrastructure.

3.1.15.2. Specific Regulatory Considerations

Federal organizations, such as OSHA, USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Arizona, this resource area is regulated by the Arizona Division of Occupational Safety and Health (ADOSH), and the ADEQ. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Arizona has an OSHA-approved “State Plan,” which has adopted all OSHA standards state and local government standards, and incorporates federal standards by reference (OSHA, 2015a). Occupational safety regulations are enforced at the state level by ADOSH and at the federal level by OSHA. Occupational and public health are regulated by the Arizona Department of Health Services (AZDHS).

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 3.1.15-1 below summarizes the major Arizona laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 3.1.15-1: Relevant Arizona Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
Arizona Administrative Code: Title 49, Chapter 2, Article 2	AZDEQ	Provides general state water quality standards, as well as standards for navigable waters and aquifers.
Arizona Administrative Code: Title 23, Chapter 2, Article 10	Arizona Department of Labor (ADOL)	Presents regulations relating to the Arizona Division of Occupational Safety & Health (ADOSH) including inspections, violation, and enforcement actions.
Arizona Administrative Code: Title 27, Chapter 1, Article 2	Arizona State Mine Inspector	Presents regulations for the inspection of mines, locating abandoned mines, and abandoned mine safety fund.
Arizona Administrative Code: Title 27, Chapter 5 & 6	Arizona State Mine Inspector, Reclamation Division	Details regulatory provision of state reclamation division such as reclamation plans, reclamation funds, and enforcement actions.

3.1.15.3.   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, 2016b). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground’s surface (OSHA, 2015b). 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 and maintenance of underground utilities, building foundations, and work in utility manholes[156] are examples of when confined space work is necessary. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width) would occur. Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. The general public can be at risk of stepping into or driving motor vehicles over open trenches, or falling into uncovered confined spaces. (OSHA, 2016c)

Heavy equipment and machinery – New and replacement deployment and maintenance activities 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 sometimes used to prepare the ground, transport materials and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks as telecommunication work sites. These pieces of machinery can potentially sever skin and bone, or cause other significant musculoskeletal injuries to the operator (OSHA, 2016c).

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work (International Finance Corporation, 2007).

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per

[156] 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.

8-hour time weighted average (TWA) (see Section 3.1.13, Noise) (OSHA, 2002). Fugitive noise may emanate beyond the telecommunication work site and impact the public living in the vicinity, observing the work, or transiting through the area (OSHA, 2016c).

Hazardous materials and hazardous waste – Work at telecommunication sites may require the storage and use of hazardous materials such as fuel sources for backup power generators and compressed gases used for welding and metal cutting (new towers only). In some cases, telecommunication sites require use of potentially hazardous products (e.g., herbicides). Secondary hazardous materials (e.g., exhaust fumes) may be a greater health risk than the primary hazardous material (e.g., diesel fuel). Furthermore, the use of hazardous materials creates down-stream potential to generate hazardous waste. While it is unlikely that any FirstNet activities would involve the generation or storage of hazardous waste, older existing telecommunication structures and sites could have hazardous materials present, such as lead-based (exterior and interior) paint at outdoor structures or asbestos tiles and insulation in equipment sheds. The general public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016c)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under wetlands and waterways, including lakes, rivers, ponds, and streams. Workers responsible for these activities operate heavy equipment from soft shorelines,[157] boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016c)

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings. (OSHA, 2016c)

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, 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

[157] Soft shorelines are stabilized using methods that incorporate natural materials, such as planting native vegetation, in order to minimize natural process impacts. Alternatively, hard shorelines are stabilized using concrete, steel, or other methods that alter the natural configuration of the shoreline. (Department of Ecology State of Washington, 2014)

and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2015, there were 3,400 telecommunication equipment installers and repairers, and 1,710 telecommunication line installers and repairers (Figure 3.1.15-1) working in Arizona (BLS, 2016b). In 2013, the most recent year data are available, Arizona had 2.1 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; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2015c) (BLS, 2015d). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Arizona has not had any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data are first available. In the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were three fatalities in 2008 in Arizona (BLS, 2015e).

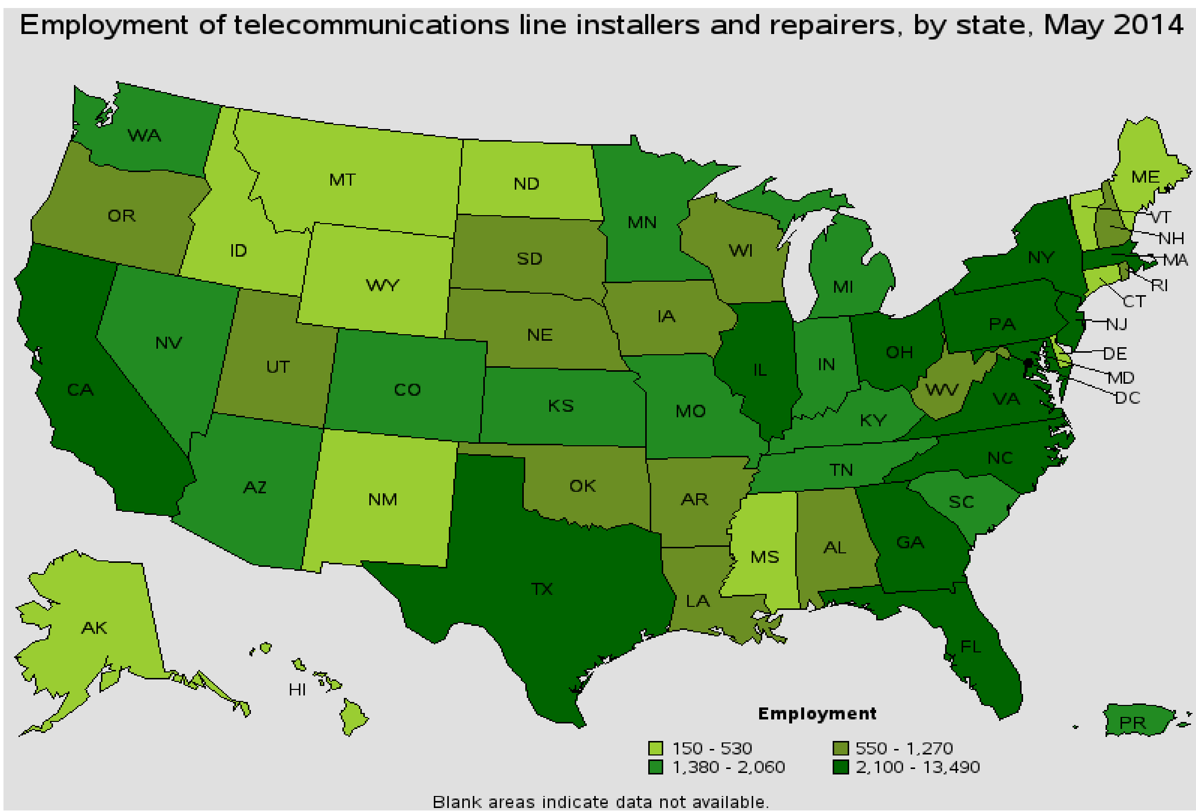


Figure 3.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015f)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. Injuries from the public to these sites does not fall within the categories of injuries that the Arizona Department of Health reports; therefore, this specific statistic is unavailable (Arizona Department of Health Services, 2015a). At the federal level, detailed public health and safety data is available through the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 1999 and 2013, there were 95 fatalities due to a fall from, out of, or through a building or structure; 30 fatality due to being caught, crushed, jammed or pinched in or between objects; and 11 fatalities due to exposure to electric transmission lines (Centers for Disease Control and Prevention, 2015). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

3.1.15.4. Contaminated Properties at or near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of telecommunication site occupants, including practices before current environmental laws, could result in environmental contamination, affecting the quality of soil, sediments, groundwater, surface water, and air.

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[158] or listed on the National Priorities List (NPL), as well as the Resource Conservation and Recovery Act (RCRA) Corrective Action sites and Brownfields. These regulated cleanup sites are known to contain environmental contaminants at concentrations exceeding acceptable human health exposure thresholds. Contact with high concentrations of contaminated media can result in adverse health effects, such as dermatitis, pulmonary and cardiovascular events, organ disease, central nervous system disruption, birth defects, and cancer. It generally requires extended periods of exposure over a lifetime for the most severe health effects to occur.

Arizona's Superfund/Water Quality Assurance Revolving Fund (WQARF), managed by the AZDEQ Remedial Projects Unit, supports cleanup efforts of hazardous waste sites and identifies high-priority sites in need of funding (ADEQ, 2015o). As of October 2015, Arizona had 34 RCRA Corrective Action sites,[159] 358 brownfield sites, and 9 proposed or final Superfund/NPL sites (USEPA, 2015j). Based on a October 2015 search of USEPA Cleanups in My Community (CIMC) database, there is one Superfund site (Iron King Mine – Humboldt Smelter in Dewey-

[158] 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).

[159] Data gathered using USEPA's Cleanups in My Community (CIMC) search on October 16, 2015, for all sites in Arizona, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013c).

Humboldt, AZ) in Arizona where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists (USEPA, 2015k).

Brownfield sites in Arizona may enroll in the state Brownfields Program, where property owners or prospective buyers may apply for federal grants to cleanup underutilized properties. ADEQ's Voluntary Remediation Program (VRP) oversees cleanup of brownfield sites (ADEQ, 2015p). One example of a State Brownfield Site is the Standin' on the Corner Park in Winslow, AZ. The half-acre site along historic Route 66 received funding for a Phase II site assessment and cleanup activities for asbestos cleanup due to a fire at the adjacent building. Soil sampling also confirmed the presence of petroleum hydrocarbons and metals. The park was cleaned up and re-opened in 2008 (ADEQ, 2015q).

Uranium mining and milling activity in Arizona 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. These tailings were occasionally used as aggregate or other residential building materials, presenting additional risk of lung cancer and kidney failure to inhabitants. Between 1944 and 1986, the federal government and the commercial industry extracted nearly 4 million tons of uranium ore within the Navajo Nation across Arizona, New Mexico, and Utah. Across Navajo Nation lands today, there are more than 500 abandoned uranium mines. USEPA, the Bureau of Indian Affairs, and other associated agencies have developed a Five-Year Plan to address uranium contamination in the Navajo Nation (DOE, 2014). 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).

The Arizona State Mine Inspector's office is responsible for regulating uranium mining activities in Arizona, including protecting human health and safety (Arizona State Mine Inspector, 2015c). Although assessment, cleanup, and health studies are ongoing in Arizona, actions already taken include prioritizing mine sites for cleanup, demolishing contaminated structures, and providing financial compensation to impacted residents (DOE, 2014). An example of Arizona uranium sites are the Cove Transfer Stations (4-acre Transfer Station 1 site and 2.5-acre Transfer Station 2 site) in Apache County, AZ. The sites were used from 1950 until 1967 as a mining field camp and uranium ore storage before transfer to an offsite mill. In 2003 to 2004, the Navajo Abandoned Mine and Land Reclamation Program excavated between one and two acres at Transfer Station 1. In 2011 to 2012, due to growing concern over potential radiation exposure, the USEPA removed uranium mine waste from Transfer Station 1 and stockpiled waste from both sites at Transfer Station 2. USEPA returned in 2013 to provide erosion control measures (USEPA, 2015l) (USEPA, 2013b).

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 not necessarily equate to chemical exposure to humans or necessarily constitute a 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). According to the USEPA, in 2013, the most recent data available, Arizona had 262 TRI reporting facilities and released 70.1 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely form the metal mining industry. This accounted for 1.72 percent of nationwide TRI releases, ranking Arizona 31 out of 56 states and territories based on total releases per square mile. (USEPA, 2015m)

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of October 15, 2015, Arizona had 82 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System. (USEPA, 2015n)

The National Institutes of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (National Institutes of Health, 2015a). Figure 3.1.15-2 provides an overview of potentially hazardous sites in Arizona.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building’s foundation. As of October 2015, there are two USEPA-regulated telecommunications sites in Arizona (U.S. Air Force – Aerostat Site and U.S. Army – Yuma Proving Ground) (USEPA, 2015o). Both sites are regulated as large quantity hazardous waste generators under RCRA, and U.S. Army – Yuma Proving Ground is additionally regulated for stationary sources of air pollution under TRI and the State Implementation Plan.

According to BLS data, in the installation, maintenance, and repair occupations, there were three fatalities (occurring in 2008) in Arizona since 2003, due to exposure to harmful substances or environments (BLS, 2015e). By comparison, the BLS reported three fatalities in 2011 and three fatalities[160] in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015g). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers occupation (SOC code

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

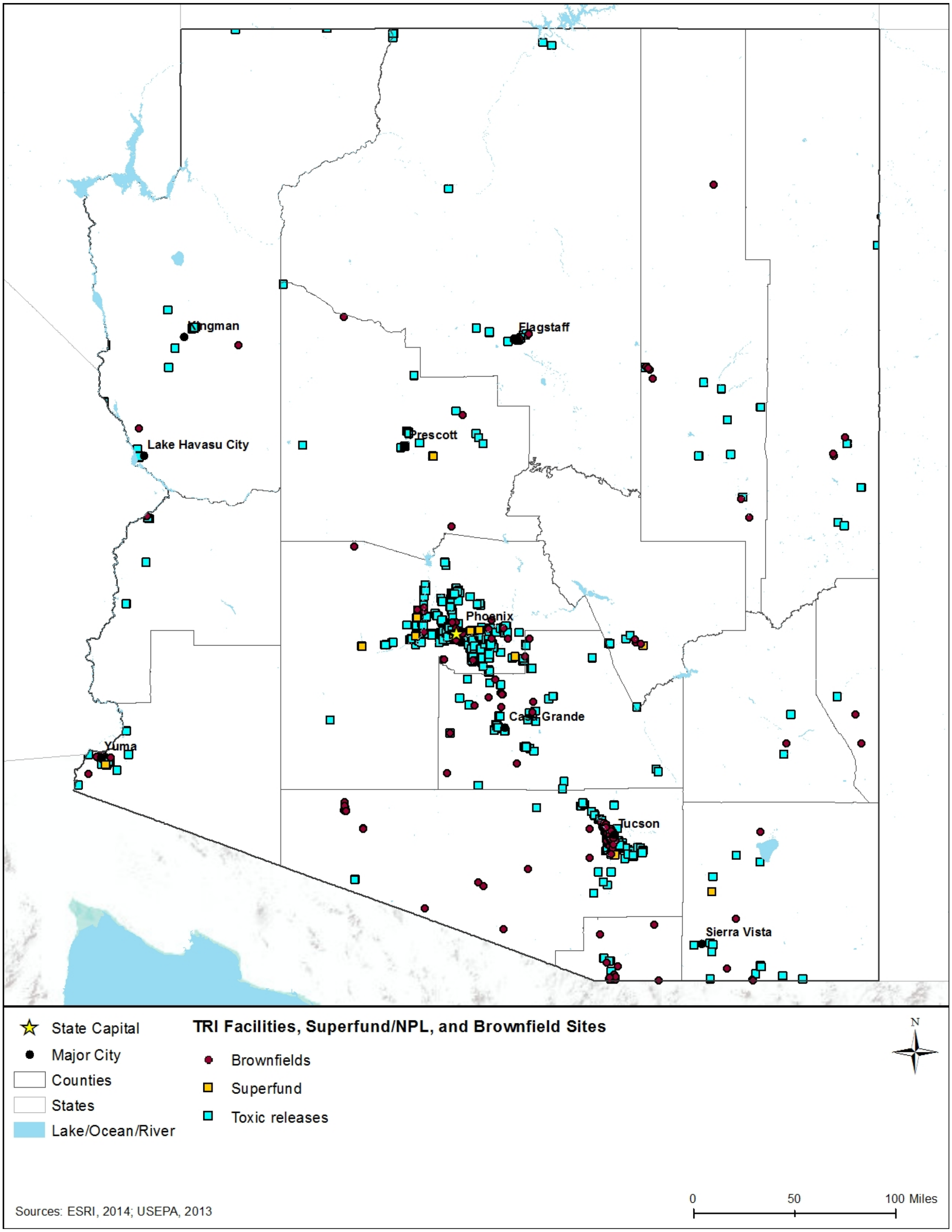


Figure 3.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Arizona (2013)

49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One

Spotlight on Arizona Superfund Sites: Iron King Mine and Humboldt Smelter

The site is comprised of two sources of releases, the Iron King Mine and the Humboldt Smelter, separated between the Town of Dewey-Humboldt, AZ (Yavapai County). Chaparral Gulch, Galena Gulch, and the Agua Fria River transect the site. The 153-acre Iron King Mine was used from 1904 until 1969 to mine lead, gold, silver, zinc, and copper, and the site is included mine tailings, waste rock piles, retention ponds, mineshafts, and areas of stained soil. The 182-acre Humboldt Smelter area operated until the 1960s, and includes exposed piles of tailings (16 acres), smelter ash (23 acres), and slag (10 acres).

At both sites, concentrations of lead and arsenic are one to two orders of magnitude above background levels in the soil, groundwater, and surface water, which is considered a serious exposure threat to human health. The USEPA has cautioned residents to limit or avoid spending time in and around the site, as health and ecological risks exist until cleanup action is completed. The site was placed on the NPL in September 2008, and cleanup plans are currently in development. As of April 2015, the USEPA has conducted soil sampling at 580 potentially impacted residential properties near the site and found that 396 required further evaluation. (USEPA, 2015w)

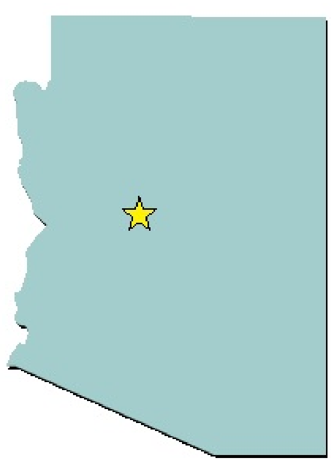


Figure 3.1.15-3: Humboldt Smelter (background) and Slag Pile (foreground)

Source: (ADEQ, 2015r)

example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors.

The AZDHS provides public health evaluations of contaminated sites when petitioned by agencies, communities, or individuals (Arizona Department of Health Services, 2015b). At the federal level, the Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography.

3.1.15.5. Abandoned Mine Lands at or near Telecommunications Sites

Another health and safety hazard in Arizona includes surface and subterranean mines, including uranium mines. In 2015, the Arizona mining industry ranked 2nd for non-fuel minerals (primarily copper, molybdenum concentrates, sand and gravel, Portland cement, and crushed stone), generating a value of $6.80 billion (USGS, 2016c). That same year, Arizona only had one surface coalmining operation (EIA, 2013). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (BLM, 2015f).

The Reclamation Division of the Arizona State Mine Inspector's office is responsible for approving reclamation plans with surface disturbances greater than 5 acres (Arizona State Mine Inspector, 2015a). As of 2015, there were approximately 24,183 abandoned hardrock mines in Arizona (Federal Mining Dialogue, 2015). Figure 3.1.15-4 shows the distribution of High

Figure 3.1.15-4: High Priority Abandoned Mine Lands in Arizona (2015)

Source: (DOI, 2015b)

Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Arizona, 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, Arizona only had one Priority 1 AML (Black Mesa Wash NE coalmine in the Navajo Nation) which has an underground mine fire (DOI, 2015c).

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs, 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 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 coalmine fires in particular, can result in evacuations of entire communities (DOI, 2015a). Promulgated by the Arizona State Mine Inspector, Arizona promotes a “Stay Out Stay Alive” program to warn the general public of the hazards associated with AMLs (Arizona State Mine Inspector, 2015b).

3.1.15.6. Environmental Setting: Natural and Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). Hazardous chemicals and sanitary wastes often contaminate floodwaters, which can cause headaches, skin rashes, dizziness, nausea, excitability, weakness, fatigue, and disease to exposed workers (OSHA, 2003). In Arizona, natural or manmade disasters could result in an uncontrolled release of radioactive material from abandoned uranium mines and mills, 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 called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, the ADOSH and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters (Arizona Division of Occupational Safety & Health, 2015). 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 113 NRC-reported incidents for Arizona in 2015 with known causes, only 1 was attributed to natural phenomenon, while 112 were attributed to equipment failure or operator error (U.S. Coast Guard, 2015). For example, during a severe storm in August 2014, storm damage to a utility pole in Waddell, Arizona, caused a discharge of about 20 gallons of transformer oil to an irrigation canal, dispersing the oil in swift water from the storm (U.S. Coast Guard, 2014). 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, Arizona reported six weather-related fatalities (two due to flooding, two due to extreme heat, and two due to lightning) and seven injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015)

Spotlight on Arizona Natural Disaster Sites: Schultz Wildfire and Flooding

In 2010, Arizona experienced a combination of wildfires and heavy rains in the San Francisco Peaks causing widespread damage to areas around Flagstaff, AZ. The fire was ignited on June 20th, by an abandoned campfire in the Coconino National Forest, northeast of Flagstaff, AZ. High winds fueled and spread the fire, forcing the evacuation of 1,000 residents. No residences were damaged by the time the fire was contained on June 30th. However, trees and other vegetation were burned over a 15,000-acre area.

Soon after the fire, heavy rains struck the area, resulting in erosion and debris flows, and flooding residential areas below the mountains. With no vegetation to prevent erosion, sediment and ash floods swept down the mountain, damaging homes and infrastructure as far as four miles from the location of the fire. Debris blocked roads, clogged bridges and culverts, and polluted public water supplies, causing a major public health concern. (AZGS, 2011c)

Figure 3.1.15-5: Schultz Fire along San Francisco Peaks FR146 (waterline) on June 24, 2010, with Timberline Estates (Flagstaff, AZ) in Foreground

Source: (AZGS, 2011c)

3.2. 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 incorporated, less than significant, or no impact. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action 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.

3.2.1. Infrastructure

3.2.1.1. Introduction

This section describes potential impacts to infrastructure in Arizona associated with construction, deployment, and operation of the Proposed Action and alternatives. Chapter 9, Best Management Practices (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.

3.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 3.2.1-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 3.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is potentially significant, but with mitigation is less than significant.	Minor delays to access to care and emergency services that do not impact health outcomes.	No impacts on access to care or emergency services.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is potentially significant, but with mitigation is less than significant.	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system ("brownouts"). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is potentially significant, but with mitigation is less than significant.	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

3.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination may be necessary with the relevant transportation authority (i.e., Arizona Department of Transportation [AZDOT], airport authorities, and railway companies) to ensure any permits or authorizations are obtained prior to deployment. Based on the impact significance criteria presented in Table 3.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if impacts would be realized at one or more isolated locations. These impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during deployment or operation phases. During deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. The only potential impact would be extremely rare, if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 3.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 3.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.

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

The AIRS Network is the primary system providing statewide interoperable communications. It also provides statewide mutual aid cross-banded capability (allowing communications across VHF, UHF, and 800 public safety LMR networks) as well as connectivity to Arizona's multiple regional public safety networks (AZDEMA, 2015a). Also, there are approximately 900 commercial towers in Colorado (FCC 2015b).

Commercial assets would be using a different spectrum for communications; as such commercial telecommunication systems, communications, or level of service would experience. 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.[161] Anticipated impacts would be less than significant due to the limited extent and temporary nature of deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The Arizona Corporation Commission (AZCC) oversees public electric utilities, aspects of water supply, and aspects of public wastewater utilities; ADEQ oversees solid waste management. 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

[161] 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.

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.

3.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to 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

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),[162] 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 as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing, telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shore or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Although lighting up of dark fiber would have no impacts on infrastructure resources as mentioned above, installation of new associated huts or equipment, if required, could impact infrastructure resources, depending on the exact siting of such installation activities.

[162] Points of Presence are connections or access points between two different networks, or different components of one network.

    - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads, could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and 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 launched or recovered on existing paved surfaces,

it is anticipated that there would be no impacts to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent impacts on utilities, if new infrastructure required tie-in to the electric grid. These impacts are expected to be less than significant 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would 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 9, 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.

3.2.1.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to infrastructure as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to infrastructure 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. 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 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to infrastructure resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment, as part of routine maintenance or inspection occurs off an established access road or utility ROW, or if additional maintenance-related construction activities occur within public road and utility ROWs, less than significant impacts would likely still occur to transportation systems or utility services due to the limited amount of new infrastructure needed to accommodate the deployables. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

3.2.2. Soils

3.2.2.1. Introduction

This section describes potential impacts to soil resources in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 3.2.2-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to soil resources addressed in this section are presented as a range of possible impacts.

Table 3.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristic	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

3.2.2.3. 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 Arizona 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 Arizona that have steep slopes (i.e., greater than 20 percent) or where there is erosion potential, including locations with Argids, Calcids, Cambids, Cryalfs, Cryepts, Durids, Fluvents, Gypsids, Orthents, Salids, Udalfs, Udepts, Udolls, Ustalfs, Ustepts, Usterts, and Ustolls suborders (see Section 3.1.2.4, Soil Suborders and Figure 3.1.2-2).

Based on the impact significance criteria presented in Table 3.2.2-1, building of some of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades. For the majority of projects, impacts to soils would be expected to be less than significant given the short-term and temporary duration of the activities.

To the extent practicable, FirstNet would attempt to minimize ground disturbing construction in areas with high erosion potential due to steep slopes or soil type. Where construction is required in areas with a high erosion potential, FirstNet could implement BMPs and mitigation measures, where practicable and feasible, to avoid or minimize impacts, and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 9).

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 3.2.2-1, and due to the relatively small-scale (less than 1 acre) of most FirstNet project sites, minimal topsoil mixing is anticipated. Implementation of BMPS and mitigation measures (see Chapter 9) could further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 3.1.2.4, Soil Suborders). The most compaction susceptible soils in Arizona are Usterts, which are hydric soils. These soils constitute approximately 0.11

percent of Arizona's land area[163] (see Figure 3.1.2-2). 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 3.2.2-1, the risk of soil compaction and rutting resulting from FirstNet deployment activities would be less than significant due to the extent of susceptible soils in the state.

3.2.2.4. 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to soil resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures and would not impact soil resources because it would not produce perceptible changes to soil resources.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite

[163] 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.

phones, and video cameras, would not impact soil resources because those activities would not require ground disturbance.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have no impact on soil resources.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
  - New Build – Submarine Fiber Optic Plant: Installation of fiber optic plants in limited nearshore or inland bodies of water could potentially impact soil resources at and near the landings or facilities on shore to accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.

  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures 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: 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. Where technologies such as COWs, COLTs, and SOWs are deployed on existing paved surfaces, there would be no impacts to soil resources because there would be no ground disturbance.

In general, the abovementioned activities could potentially involve land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to soil resources associated with deployment of this infrastructure could include soil erosion, topsoil mixing, or soil compaction and rutting. These impacts are expected to be less than significant as the activity would likely be short term, localized to the deployment locations, and would return to normal conditions as soon as revegetation occurs, often by the next growing season. It is expected that heavy equipment would utilize existing roadways and utility rights-of-way for deployment activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described 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 due to the temporary nature and small scale of operations activities with the potential to create impacts. Chapter 9, 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.

3.2.2.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to soil resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to soils could occur on paved surfaces if the acceptable load of the surface is exceeded. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities may result in soil compaction and rutting. In addition, implementation of deployable technologies themselves could also result in soil compaction and rutting if deployed in unpaved areas. However, these potential impacts are expected to be less than significant due to the small scale and short term nature of the deployment. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, less than significant soil compaction and rutting impacts 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 as described above. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to soil resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.2, Soils.

3.2.3. Geology

3.2.3.1. Introduction

This section describes potential impacts to Arizona geology resources associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 3.2.3-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geology addressed in this section are presented as a range of possible impacts.

Table 3.2.3-1: Impact Significance Rating Criteria for Geology

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
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.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMP and Mitigation Measures Incorporated	Less than Significant	No Impact
	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
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.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMP and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory		State/territory	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA = Not Applicable

3.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the project, such as seismic hazards, landslides, and volcanic activity, and those that would be impacts from the project, such as land subsidence and effects on mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic 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 3.1.3, the majority of Arizona is at low to moderate risk of significant earthquake events. Between 1973 and March 2012, there were 5 earthquakes of a magnitude 4.5 (on the Richter scale[164]) or greater in Arizona (FAA, 2012). As shown in Figure 3.1.3-5, areas of greatest seismicity in Arizona are concentrated in the northwestern and southwestern portions of the state, though earthquakes over magnitude 6.0 on the Richter scale are rare in the state. Based on the impact significance criteria presented in Table 3.2.3-1, seismic impacts from the deployment or operation of the Proposed Action would have no impact on seismic activitiy; however, seismic impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for minor to moderate earthquakes in parts of Arizona, some amount of infrastructure could be subject to earthquake hazards. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Volcanic Activity

Volcanoes were considered but not analyzed for Arizona, as they do not occur in Arizona; 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 those activities could result in connectivity loss.

As discussed in Section 3.1.3, the majority of Arizona is at low to moderate risk of experiencing landslide events. The highest potential for landslides in Arizona is found in the northern, mountainous areas. Most landsliding events across the state have occurred as a result of

[164] 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, 2014g)

torrential rains. Based on the impacts significance criteria presented in Table 3.2.3-1, potential impacts associated with landslides from deployment or operation of the Proposed Action would have less than significant impacts as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas in which landslides are highly prevalent. To the extent practicable, FirstNet would likely avoid deployment in areas that are susceptible to landslide events. However, given that several of Arizona's major cities, including Phoenix, Tucson, and Flagstaff, are in areas that experience landslides with moderate to high frequency, some amount of infrastructure could be subject to landslide hazards. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Land Subsidence

Equipment that is exposed to land subsidence, such as sinkholes created by karst topography is subject to misalignment, alteration, or in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, could lead to inundation of equipment. Any of these activities could result in connectivity loss.

As discussed in Section 3.1.3.8 and shown in Figure 3.1.3-6, portions of Arizona are vulnerable to land subsidence due to aquifer compaction (caused by lowering of the water table), compaction of silt and clay aquifer units, and the development of earth fissures. Based on the impact significance criteria presented in Table 3.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would 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 mining areas. To the extent practicable, FirstNet would likely avoid deployment in known areas of karst topography or where mine collapse is possible. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures could help avoid or minimize the potential impacts. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources is not likely to affect these resources. New construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 3.2.2-1, impacts to mineral and fossil fuel resources is unlikely, as the Proposed Action could only be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable, FirstNet would likely avoid construction in areas where these resources exist. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential 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 3.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 3.1.3.6, fossils are present throughout portions of the state, with marine and terrestrial fossils present in the Grand Canyon and dinosaur fossils at Petrified Forest Natural Park (Paleontology Portal, 2015b) (Paleontology Portal, 2015d). 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. Potential impacts to paleontological resources would likely be considered on a site-by-site basis. Implementation of BMPs and mitigation measures could further help avoid or minimize potential impacts. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in 3.2.3-1, 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 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.3.4. 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to geology under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. In most cases, there would be no impacts to geologic resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on geologic resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact geologic resources, it is anticipated that this activity would have no impact on geologic resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to geologic resources, or resulting from geologic hazards due to implementation of the Preferred Alternative, would encompass a range of impacts that could occur as a result of ground disturbance activities, including loss of mineral and fuel resources and paleontological resources. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to geologic resources, or impacts from geologic hazards, include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities, or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, land subsidence, 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, land subsidence, and other geologic hazards, it is possible that equipment could be affected by that hazard.
   - Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, land subsidence, and other geologic hazards, it is possible that equipment could be affected by that hazard.
   - New Build – Submarine Fiber Optic Plant: The installation of cables in 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, land subsidence, and other geologic hazards, it is possible that equipment could be affected by that hazard.
   - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
- Wireless Projects
   - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, land subsidence, and other geologic hazards, it is possible that equipment could be affected by that hazard.
   - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if 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, land subsidence, and other geologic hazards, it is possible that equipment could be affected by that hazard.
   - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location

proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. Where deployable technologies would be implemented on existing paved surfaces, there would be no impacts to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: In most cases, the installation of permanent equipment on existing structures, adding equipment to satellites launched for other purposes, or the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, land subsidence, 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 projects are likely to be small-scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small-scale. As a result, potential impacts are expected to be less than significant. For the same reason, impacts to deployment from geologic hazards are likely to be less than significant as well. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of 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 geological resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant 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 9, 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.

3.2.3.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These impacts are expected to be less than significant due to the minor amount of paving or new infrastructure needed to accommodate the deployables. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to geologic resources (or from geologic hazards) associated with routine inspections of the Preferred Alternative because there would be no ground disturbance.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic activity, volcanic activity, landslides, and land subsidence. However, potential impacts would be anticipated to be less than significant 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to geologic resources (or from geologic hazards) as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.3, Geology.

3.2.4. Water Resources

3.2.4.1. Introduction

This section describes potential impacts to water resources in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 3.2.4-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

Table 3.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: CWA, SDWA.	Effect that is potentially significant, but with mitigation is less than significant.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Floodplain degradation*	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with mitigation is less than significant.	Activities occur inside the 500-year floodplain, but do not use fill, do not substantially increase impervious surfaces, or place structures that will impede or redirect flood flows or impact floodplain hydrology, and do not occur during flood events. Low likelihood of encountering a 500-year floodplain within a state or territory.	Activities occur outside of floodplains and therefore do not increase fill or impervious surfaces, nor do they impact flood flows or hydrology within a floodplain.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than one season or water year, or occurring only during an emergency.	NA
Drainage pattern alteration	Magnitude or Intensity	Alteration of the course of a stream of a river, including stream geomorphological conditions, or a substantial and measurable increase in the rate or amount of surface water or changes to the hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any alterations to the drainage pattern are minor and mimic natural processes or variations.	Activities do not impact drainage patterns.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, lasting no more than six months.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Flow alteration	Magnitude or Intensity	Consumptive use of surface water flows or diversion of surface water flows such that there is a measurable reduction in discharge.	Effect that is potentially significant, but with mitigation is less than significant.	Minor or no consumptive use with negligible impact on discharge.	Activities do not impact discharge or stage of waterbody (stream height).
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact occurs in perennial streams, and is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is potentially significant, but with mitigation is less than significant.	Any potential impacts to groundwater or aquifers are temporary, lasting no more than a few days, with no residual impacts.	Activities do not impact groundwater or aquifers.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Impact is ongoing and permanent.		Impact is temporary, not lasting more than six months.	NA

* Since public safety infrastructure is considered a critical facility, 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

3.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Of the three percent of Arizona's rivers and streams assessed, almost half (45 percent) are impaired (see Table 3.1.4-2 and Figure 3.1.4-3). Impacts from abandoned mine lands and mine tailings, rangeland grazing, irrigated crop production, and sources outside of the state have contributed to current water quality in the state. Designated uses include agricultural irrigation, agricultural livestock watering, aquatic and wildlife, fish consumption, and "full[165] and partial body contact"[166] (USEPA, 2015a). "All aquifers in Arizona are classified for drinking water protected use (A.R.S. § 49-224(B)) unless otherwise designated by the Director after review and consultation described in A.R.S. §49-224(C). To date, no aquifers in Arizona have been reclassified to a non-drinking water protected use" (ADEQ, 2016b).

Deployment activities could contribute to water quality impacts 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. Water quality could also be impaired by actions that introduce or cause bacteria such as coliform or *E. coli*, or change other water chemistry.

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, an AZPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be

[165] Full body contact: "The use of a surface water for swimming or other recreational activity that causes the human body to come into direct contact with the water to the point of complete submergence. The use is such that ingestion of the water is likely and sensitive body organs, such as the eyes, ears, or nose, may be exposed to direct contact with the water." (18 A.A.C. 11, Article 1, 2009)

[166] Partial body contact: "Recreational use of a surface water that may cause the human body to come into direct contact with the water, but normally not to the point of complete submergence (for example, wading or boating). The use is such that ingestion of the water is not likely and sensitive body organs, such as the eyes, ears, or nose, will not normally be exposed to direct contact with the water." (18 A.A.C. 11, Article 1, 2009)

implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

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 are not expected to violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 3.2.4-1, water quality impacts would likely be less than significant, and could be further reduced particularly if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching[167] 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 Arizona 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.

There is little potential for groundwater contamination within a watershed or multiple watersheds. As a result, 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. Thus, based on the impact significance criteria presented in Table 3.2.4-1, 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, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on human beings, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood

[167] 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 3.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would 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,[168] 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 9).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could changes drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 3.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered less than significant.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Where stormwater is contained on site and does not flow to or impact surface waterbodies off-site on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.

[168] 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."

- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant impacts.

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 3.2.4-1. 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 but is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs and mitigation measures could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 3.1.4.7, approximately 43 percent of Arizona residents rely on groundwater as a source of potable water (AZDWR, 2016). Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. “All aquifers in Arizona are classified for drinking water protected use (A.R.S. § 49-224(B)) unless otherwise designated by the Director after review and consultation described in A.R.S. §49-224(C). To date, no aquifers in Arizona have been reclassified to a non-drinking water protected use" (ADEQ, 2016b). Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would be unlikely to cause significant impacts due to the expected small volume of these materials. Activities that may cause changes is 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.
- Commercial generation, treatment, storage, or disposal of hazardous wastes.

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 would likely have be less than significant impacts since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should be considered to avoid areas that would extract groundwater from potable groundwater sources in the area. According to Table 3.2.4-1, 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 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.4.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1, Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to water resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions. The impact on the water resources that could be affected would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to water resources under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to water resources since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on water resources because there would be no ground disturbance.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact water resources because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact water resources, it is anticipated that this activity would have no impact on water resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to water resources because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including impaired water quality. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to water resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to water resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation

technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity.

- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment would be required to marine and shoreline environments prior to installation to fully assess potential impacts to lake or river coastal environments.
- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Ground disturbance activities could cause impacts to water quality from increased suspended solids; groundwater impacts from trenching activities are not expected. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
- Collocation on Existing Aerial Fiber Optic Plant: Replacement of poles or structural hardening could result in ground disturbance that could cause impacts to water quality from increased suspended solids
- 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. The trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs and mitigation measures could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - 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 due to the small-scale of individual activities. Chapter 9, 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.

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 due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities, and are expected to have no impacts as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility ROWs. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. Chapter 9, 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.

3.2.4.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources if those activities occurred on paved surfaces. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving, 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, could 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. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the 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 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, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. 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. Site maintenance, including mowing or herbicides, may result in less than significant effects to water quality, due to the small-scale of expected FirstNet activities in any particular location. In addition, the presence of new access roads could increase the overall amount of impervious surface in the area, and increase runoff effects on water resources, as explained above. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to water resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.4, Water Resources.

3.2.5. Wetlands

3.2.5.1. Introduction

This section describes potential impacts to wetlands in Arizona associated with deployment and operation of the Proposed Action and Alternatives. Chapter 9, 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.

3.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 3.2.5-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

Table 3.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Direct wetland loss (fill or conversion to non-wetland)	Magnitude or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA

Type of Effect	**Effect Characteristics**	**Impact Level**			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration	NA
Indirect Effects: [2] Change in Function(s)[3] 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.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

[1] "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.
[2] 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.
[3] 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

3.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 9).

The majority of freshwater wetlands in Arizona are found in riparian areas, and include marshes, bosques, cienegas,[169] and oxbow lakes. Non-riparian wetlands include playas, caldera lakes, and tinajas.[170] These wetlands comprise less than one percent of Arizona, and the extremely arid climate, along with seasonal precipitation that varies from year to year, heavily influence the amount and distribution of wetlands in the state. There are currently approximately 380,000 acres of wetlands in the state (USFWS, 2014a).

Based on the impact significance criteria presented in Table 3.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, it is unlikely the deployment activities would violate applicable federal, state, and local regulations. In Arizona, as discussed in Section 3.1.5, Wetlands, there are no regulated high quality wetlands. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet

[169] Cienegas are wetlands associated with headwater streams and perennial streams. The water source barely fluctuates, and the soils are permanently saturated (BLM, 1987).

[170] Tinajas are depressions formed in bedrock. Sometimes referred to as potholes or weathering pits, they range in depth from less than one meter to over two meters, and are characterized by species such as cottonwood, willow, Baltic rush, common reed, and evening primrose (McKinstry, Hubert, & Anderson, 2004).

and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Other Direct Effects

Other direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, other direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through chemical, mechanical, or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 3.2.5-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) may cause potentially significant impacts. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Examples of activities that could have other direct effects to wetlands in Arizona include:

- *Vegetation Clearing:* removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance:* Increased amounts of stormwater runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- *Direct Hydrologic Changes (flooding or draining):* Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- *Direct Soil Changes:* Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameter.

- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[171] Change in Function(s)[172] 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 given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures, as practicable and feasible (see Chapter 9).

Examples of functions related to wetlands in Arizona 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.
- *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

[171] 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.

[172] 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.

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 3.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially less than significant. As there are no regulated high quality wetlands in Arizona, deployment activities could have less than significant indirect impacts on wetlands in the state. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations would be required to determine the exact location of all wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetlands and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to wetlands under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there

would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

   - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on wetlands because there would be no ground disturbance.

- Satellites and Other Technologies
   - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, 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 be very unlikely to impact wetlands, it is anticipated that this activity would have no impact on wetlands.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wetlands because of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct effects, other direct effects, and indirect effects on wetlands. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to wetlands include the following:

- Wired Projects
   - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wetlands. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct and indirect impacts to wetlands. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected. 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 or inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments.
   - 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 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, or piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant due to the small about of land disturbance (generally less than one acre) and the short timeframe of deployment activities. To further minimize any potential impacts to wetlands, BMPs and mitigation measures could be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing potential other direct impacts to wetlands if heavy equipment is used for routine operations and maintenance application of herbicides occurs to control vegetation along all ROWs and near structures, depending on the proximity to wetlands. The intensity of the impact depends on the amount of herbicides used, frequency, and location of nearby sensitive wetlands. These impacts are expected to be less than significant due to the limited nature of deployment activities. It is also anticipated that routine maintenance activities would be conducted on existing roads and utility ROW. Chapter 9, 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.

3.2.5.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred

Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small-scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be less than significant impacts to wetlands associated with routine inspections of the Deployable Technologies Alternative as it is likely existing roads and utility rights-of-way would be utilized for maintenance and inspection activities. Site maintenance, including mowing or herbicides, is anticipated to result in less than significant effects to wetlands due to the limited nature of site maintenance activities, including mowing and application of herbicides. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.5, Wetlands.

3.2.6. Biological Resources

3.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Arizona associated with deployment and operation of the Proposed Action and its Alternatives. Chapter 9, 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.

3.2.6.2. 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 3.2.6-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 3.2.6.3, 3.2.6.4, and 3.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 3.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Arizona.

Table 3.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristic	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: 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 BMPs and mitigation measures is less than significant.	Individual mortality observed but not sufficient to affect population or sub-population survival.	No direct individual injury or mortality would be observed.
	Geographic Extent	Regional effects observed within Arizona for at least one species. Anthropogenic 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 Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Habitat alteration in locations not designated as vital or critical for any period. Temporary losses to individual plants within cover types, or small habitat alterations take place in important habitat that is widely distributed and there are no cover type losses or cumulative effects from additional projects.	Sufficient habitat would remain functional to maintain viability of all species. No damage or loss of terrestrial, aquatic, or riparian habitat from project would occur.
	Geographic Extent	Regional effects observed within Arizona 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 Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Individual injury/mortality observed but not sufficient to affect population or sub-population survival. Partial exclusion from resources in locations not designated as vital or critical for any given species or life stage, or exclusion from resources that takes place in important habitat that is widely distributed. Anthropogenic disturbances are measurable but minimal as determined by individual behavior and propagation, and the potential for habituation or adaptability is high given time.	No stress or avoidance of feeding or important habitat areas. No reduced population resulting from habitat abandonment.
	Geographic Extent	Regional or site specific effects observed within Arizona 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 Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Temporary loss of migratory rest stops due to anthropogenic activities take place in important habitat that is widely distributed and there are no cumulative effects from additional projects.	No alteration of migratory pathways, no stress, or avoidance of migratory paths/patterns due to project.
	Geographic Extent	Regional effects observed within Arizona 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
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 BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.

Type of Effect	Effect Characteristic	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Geographic Extent	Regional effects observed within Arizona for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Arizona.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

NA = Not Applicable

3.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Arizona 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 3.2.6-1, 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. The implementation of BMPs and mitigation measures and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival. Chapter 9, 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.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. Areas near population centers have experienced extensive land use changes from urbanization and agriculture. However, a large portion of the state is arid and semi-desert, and remains relatively unfragmented (AZGFD, 2012a).

Construction of new infrastructure and long-term facility maintenance could result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. In general, these impacts are expected to be less than significant 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 would be recommended and consultation with appropriate resource agencies if required would be undertaken to minimize or avoid potential impacts. Chapter 9, 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.

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 due to the short-term and small-scale nature of deployment activities. Chapter 9, 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.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action, given the small-scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action, given the small-scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity. The Arizona Noxious Weed Law (ARS §3-201) stipulates that the ADA be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. The Act further stipulates that the ADA is responsible for implementing and enforcing noxious weed management. In addition, individual districts within a county may organize an antinoxious weed district for the purposes of eradication and control of noxious weed species within their district, as defined by the ADA noxious weed species list (ARS §48-301 et seq.). The ADA regulates noxious weeds within the state under three categories: species that are prohibited from entry into the state; species that are regulated and if found within the state may be controlled or quarantined to prevent further infestation; and restricted species that if found within the state shall be quarantined to prevent further infestation.

A total of 55 state-listed noxious prohibited, regulated, or restricted plants are regulated in Arizona as set forth in the ARS §3-201. Of these species, 49 are terrestrial and 6 are aquatic species (ADA 2006). Nine of these species occur on the Federal Noxious Weed List (USDA 2014).

As described in Section 3.1.6.4, 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 due to the small-scale, localized nature of deployment activities. BMPs and mitigation measures could help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action. Chapter 9, 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.

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, 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,[173] and the nature as well as the extent of the habitats affected. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Activities Likely to Have No Impacts</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to 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

[173] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on terrestrial vegetation because there would be no ground disturbance.

- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

<u>Activities with the Potential to Have Impacts</u>

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 avoid or minimize potential impacts.
    - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.

- Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cables could potentially occur as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.

- Wireless Projects
  - New Wireless Communication Tower: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.

- Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. These potential impacts are expected to be less than significant due to the small-scale of expected deployment activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would no impacts to terrestrial vegetation associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or herbicides, may result in less than significant effects 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 due to the small-scale of expected activities. Chapter 9, 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.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. However, impacts are expected to remain less than significant due to the relatively small-scale of FirstNet activities at individual locations. Chapter 9, 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.

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. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation associated with routine operations, and maintenance due to the relatively small-scale of likely FirstNet project sites. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. There would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.3, Terrestrial Vegetation.

3.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are discussed in this section. Chapter 9, BMPs and Mitigation Measures, provides a listing 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 3.2.6-1, less than significant impacts would be anticipated given the anticipated small size and nature of the majority of the proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet Proposed Actions, 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, as discussed further below. Chapter 9, 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.

<u>Terrestrial Mammals</u>

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Arizona. 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 tree-roosting bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

<u>Birds</u>

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and may violate the MBTA and/or the BGEPA. 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 (Gehring, J., Kerlinger, P. and A. Manville, 2011).

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for nesting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, 1997).

Direct mortality and injury to birds of Arizona are not likely to be widespread or affect populations of species as a whole; impacts to individual birds may be realized depending on the nature of the deployment activity. Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small-scale of likely FirstNet actions. If siting considerations and BMPs and mitigation measures are implemented (Chapter 9), potential impacts could be minimized. Additionally, potential impacts under MBTA and BGEPA could be addressed through BMPs and mitigation measures developed in consultation with USFWS.

Reptiles and Amphibians

The majority of Arizona’s amphibian and reptile species are widely distributed throughout Arizona. Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Arizona are so widely distributed that injury/mortality events are not expected to affect populations of species as a whole.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat, and impeding access to resources and mates. Areas near population centers have experienced extensive land use changes from urbanization and agriculture. However, a large portion of the state is arid and semi-desert, and remains relatively unfragmented.

Additionally, habitat loss could occur through exclusion, directly or indirectly, preventing an animal from accessing an optimal habitat (e.g., breeding, forage, or refuge), either by physically preventing use of a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is expected that activities associated with the Proposed Action 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 because of the small-scale nature of expected deployment activities. These potential impacts are described below for Arizona's wildlife species. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Arizona and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals 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 that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures, as practicable and feasible (see Chapter 9).

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS provides regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, 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, 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[174] species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stopovers (e.g., shorebirds). BMPs and mitigation measures,

[174]Passerines are an order of "perching" birds that have four toes, three facing forward and one backward, which allows the bird to easily cling to both horizontal and nearly vertical perches.

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 Arizona's amphibians and reptiles typically consist of wetlands, upland forests in the mountainous northern areas, and semi-desert areas throughout the state. Impacts are expected to be less than significant 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 9) could be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 3.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Arizona's amphibian and reptile populations, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.[175]

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species' declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 3.2.6.6, Threatened and Endangered Species and Species of Concern.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. Overall, impacts are expected to remain less than significant due to the short-term nature and limited geographic scope of expected activities, though BMPs and mitigation measures could help to further avoid or minimize the potential impacts. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

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 result 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 not occur.

[175] See Section 3.2.5, Wetlands, for a discussion of BMPs for wetlands.

<u>Birds</u>

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, 1997). The majority of FirstNet deployment activities would be short-term in nature, and repeated disturbances would not occur.

<u>Reptiles and Amphibians</u>

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.

<u>Terrestrial Invertebrates</u>

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are expected to be less than significant due to the small-scale and localized nature of expected activities. Potential effects to migration patterns of Arizona's terrestrial mammals, birds, reptiles and amphibians, and terrestrial invertebrates are described below. Chapter 9, 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.

<u>Terrestrial Mammals</u>

Large game animals have well-defined migratory routes. Route knowledge is passed on from one generation to the next and includes important feeding and calving areas. Small mammals also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[176]

Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant because they would be unlikely to result in long-term avoidance. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

[176] A location chosen by an animal for hibernation.

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. Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significant given the short-term nature and limited geographic scope for individual activities. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

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 given the short-term nature and limited geographic scope for individual activities. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Arizona's terrestrial invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Overall, potential impacts are expected to be less than significant due to the small-scale and localized nature of expected activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and calving grounds for large mammals has the potential to negatively affect body condition and reproductive success of mammals in Arizona.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small-scale and impacts are expected to be less than significant. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, 1997). The majority of FirstNet deployment or operation activities are likely to be small-scale in nature. 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 3.2.6.6, Threatened and Endangered Species.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the spotted turtle leaves its breeding pool in May and travels to its nesting site.

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, or alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though BMPs would help to avoid or minimize the potential impacts.

Terrestrial Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; therefore, no reproductive effects to terrestrial invertebrates are expected as a result of the Proposed Action.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources. Arizona has not adopted official regulations regarding invasive wildlife species. However, the Arizona Invasive Species Council and AZGFD have presented information on select wildlife species considered invasive in Arizona and that have the potential to impact the state’s biodiversity.

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.

Potential invasive species effects to Arizona’s wildlife are described below.

Terrestrial Mammals

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.

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.

Reptiles and Amphibians

Although not currently regulated in Arizona, the red-eared slider (a turtle species) and African clawed frog are both present in the state. Both of these species are highly adaptable and could threaten native wildlife by competing with them for food sources and also spread disease (AZGFD, 2013b).

Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites as part of the deployment activities. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers. Invasive species effects to reptiles and amphibians could be minimized following the BMPs and mitigation measures, as practicable or feasible, described in Chapter 9.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects could pose a large threat to Arizona's forest and agricultural resources. Species such as the pine bark beetle are of particular concern in Arizona and are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. BMPs and mitigation measures could help to avoid or minimize the potential for introducing invasive terrestrial invertebrate species during implementation of the Proposed Action. Invasive species effects related to terrestrial invertebrates could be minimized with the implementation of BMPs and mitigation measures. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology,[177] and the nature and extent of the habitats affected. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to wildlife resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and unlikely to produce measurable changes in wildlife behavior. It is anticipated that effects to wildlife would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on wildlife resources because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, 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

[177] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure 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, 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 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 the banks of waterbodies that accept submarine cables could potentially impact wildlife (see Section 3.2.4, Water Resources for a discussion of potential impacts to water resources). Potential effects could include direct injury/mortality; habitat loss, alteration, or fragmentation depending on the site location. If activities occurred during critical

periods, effects to migratory patterns as well as reproductive effects and indirect injury/mortality could occur.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening were required, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. RF hazards could result in indirect injury or mortality as well as reproductive effects depending on duration and magnitude of operations. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions. Deployment of drones, balloons, blimps, aerostats, or piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant given the small-scale of likely individual FirstNet projects; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources associated with routine inspections of the Preferred Alternative. Site maintenance would be infrequent, including mowing or limited application of herbicides, may result in less than significant effects to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides. 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.

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 individual wildlife species and unlikely to cause population-level impacts, and therefore would likely than less than significant given the short-term nature and limited geographic scope for individual activities. Chapter 9, 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.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. Chapter 9, 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.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. The impacts could vary greatly among species and geographic region. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wildlife resources as a result of construction and operation of the

Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.4, Terrestrial Wildlife.

3.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Arizona are discussed in this section. Chapter 9, 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.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events (USEPA, 2012d).

Based on the impact significance criteria presented in Table 3.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (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

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, the construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location depending on the nature of the deployment activity. Additionally, deployment activities with potential impacts to sensitive aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

Water quality impacts from exposure to contaminants from accidental spills from vehicles and equipment, and erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. These impacts are expected to be less than significant due to the short-term nature and limited geographic scope of deployment activities. BMPs and mitigation measures to protect water resources (see Section 3.2.4, 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 are anticipated to be localized and small-scale; therefore, potential impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure are not anticipated and therefore impacts are expected to be less than significant. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invasive Species Effects

The potential to introduce invasive plants within construction zones could occur from vessels 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; 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, impacts are anticipated to be less than significant. BMPs and mitigation measures would help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. Chapter 9, BMPs and Mitigation Measures, provides a listing of the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to fisheries and aquatic habitats under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that effects 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

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 could, if conducted near water resources that support fish, 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, associated with the above activities could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects.
    - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, particularly near water resources that support fish, such disturbance

could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to fisheries and aquatic habitats, if such actions were deployed near water resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads, particularly if they occur near waterbodies, could result in habitat loss or indirect injury/mortality, and invasive species effects, although highly unlikely. Refer to Section 2.4, Radio Frequency Emissions, for more information on RF emissions.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to fisheries and aquatic habitats. However, if new power units, replacement towers, structural hardening, or physical security measures required ground disturbance, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
    - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
    - Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant due to the small scale and localized nature of deployment activities that have the potential to impact aquatic habitats. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that may result in accidental spills from maintenance equipment or pesticide runoff near fish habitat are expected to have less than significant effects to fisheries and aquatic habitats. Potential spills of these materials would be expected to be in small quantities.

Fisheries and aquatic habitat could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant 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 9, 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.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the

Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts 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 due to the limited nature of expected deployment activities. Chapter 9, 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.

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 there would be less than significant impacts to fisheries and aquatic habitats associated with routine operations and maintenance due to the limited nature of expected deployment activities. The impacts could vary greatly among species and geographic region. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to fisheries and aquatic habitats as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.5, Fisheries and Aquatic Habitats.

3.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Arizona 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 9, 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 3.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect. Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 3.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	
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.

Type of Effect	Effect Characteristic	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
	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 3.2.6-2, any direct injury or mortality of a listed species at the individual-level, as well as any impact that has the potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency, may affect and likely adversely affect a listed species. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Arizona 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Mammals</u>

Arizona is home to nine federally listed mammal species protected under the ESA, including both large and small mammals. They are the black-footed ferret, gray wolf, Hualapai Mexican vole, jaguar, lesser long-nosed bat, mount graham red squirrel, New Mexico meadow jumping mouse, ocelot, and Sonoran pronghorn.

Direct mortality or injury to these species is unlikely. However, isolated vehicle strikes could occur, as these species are occasionally found along transportation corridors. In addition, the direct mortality or injury to the federally listed lesser long-nosed bat could occur if caves or mines were flooded or blocked off while bats were present. While projects would not likely directly affect hibernacula (e.g., caves), human disturbance in and around these sites when bats are present could lead to effects to these species; when disturbed by noise or light, bats awaken resulting in a loss of body fat needed to help them survive in the spring (Washington Department of Fish and Wildlife, 2016). Impacts would likely be isolation, individual events and therefore may affect, but are not likely to adversely affect, a listed species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

Five endangered and two threatened bird species are known to occur within Arizona; they are the California condor, California least tern, masked bobwhite quail, Mexican spotted owl, southwestern willow flycatcher, western yellow-billed cuckoo, and Yuma clapper rail. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts may affect, but are not likely to adversely affect, listed species as FirstNet would attempt to avoid deployment activities in these areas. 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 9, may be implemented as appropriate to further minimize potential impacts.

Fish

Arizona is home to 13 endangered and six threatened fish species, as summarized in Table 3.1.6-6. Direct mortality or injury to these endangered 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 9, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One federally endangered and one threatened amphibian species are known to occur in Arizona: the Sonora tiger salamander and Chiricahua leopard frog, respectively, found within wetland areas, water seeps, and stock tanks. In addition, four threatened reptile species are federally listed in Arizona; they are the desert tortoise, narrow-headed gartersnake, New Mexican ridge-nosed rattlesnake, and Northern Mexican gartersnake.

Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes. Potential effects would likely be isolated, individual events; FirstNet would attempt to avoid areas where the species may occur. Direct mortality or injury could occur from watercraft and vessels strikes, yet are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts may affect, but 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 9, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Two endangered and one threatened invertebrate occur in Arizona; they are the Kanab ambersnail, San Bernardino springsnail, and the Three Forks springsnail.

Direct mortality or injury could occur to these species if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. Distribution of these species is very limited throughout the state, as some species are only found in a few counties. FirstNet would attempt to avoid areas where these species may occur; therefore potential impacts may affect, but are not likely to adversely affect, listed species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Plants

Fourteen endangered and seven threatened plant species are known to occur in Arizona, as summarized in Table 3.1.6-9. 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 very limited throughout the state. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Arizona are described below.

Terrestrial Mammals

Noise, 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 may inhibit access or cause den abandonment by gray wolves. 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 9, may be implemented as appropriate to further minimize potential impacts.

Birds

The California least tern and the western yellow-billed cuckoo are federally listed bird species known to nest along manmade settling ponds and forested riparian areas in Arizona, respectively. Noise, light, or human disturbance within nesting areas could cause California least tern or western yellow-billed cuckoos to abandon their nests or relocate to less desirable locations, or may result in stress to individuals, reducing survival and reproduction. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts

Reptiles and Amphibians

One federally endangered amphibian, one threatened amphibian, and four threatened reptile species are listed for Arizona. Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress to listed species, such as the Chiricahua leopard frog, resulting in lower productivity. Land clearing activities, noise, and human disturbance during the critical time periods (e.g., mating, nesting) could lower fitness and productivity. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Fish

Deployment activities resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 3.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction for the 13 endangered and 6 threatened fish species in Arizona are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality from ground disturbing activities could cause stress resulting in lower productivity for the federally listed snail species known to occur in Arizona. Potential impacts to listed invertebrate species may affect, but are not likely to adversely affect, those species as FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could result from ground disturbing activities to listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Arizona are described below.

<u>Mammals</u>

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect breeding and foraging sites of the federally listed terrestrial mammals, resulting in reduced survival and productivity. However, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed terrestrial mammals. Ground disturbing activities could impact food sources for the federally listed terrestrial mammals in Arizona. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon breeding locations or alter migration patterns. Terrestrial mammals have the capacity to divert from sound sources during feeding and migration. FirstNet would attempt to avoid areas where these species would 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 9, 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 or noise) or habitat loss/fragmentation could cause stress to individuals causing them to abandon areas for less desirable habitat and potentially reduce over fitness and productivity. Activities related to the Proposed Action, such as aerial deployment or construction activities, could result in effects to federally listed birds. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Reptiles and Amphibians</u>

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of Arizona' reptiles and amphibian species, resulting in reduced survival and productivity, however, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed reptiles or amphibians. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Fish</u>

Changes in water quality as a result of ground disturbing activities could impact food sources for some of Arizona's 13 endangered and 6 threatened fish species. Further, increased human disturbance, noise, and vessel traffic could cause stress to these species causing them to abandon spawning locations or altering migration patterns. Behavioral changes to these species, such as the shortnose sturgeon, 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Invertebrates</u>

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 the federally listed invertebrate species could impact foraging behavior. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Plants</u>

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to potential 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 terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with designated critical habitat in Arizona are described below.

Terrestrial Mammals

Designated critical habitat for the jaguar, Mount Graham red squirrel, and New Mexico meadow jumping mouse occur in southeastern and northeastern Arizona (Figure 3.1.6-3). Land clearing, excavation activities, and other ground disturbing activities in these regions of Arizona could lead to habitat loss or degradation, which could affect these species depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Birds

Two of the seven federally listed bird species in Arizona have federally designated critical habitat. Critical habitat for the Mexican spotted owl has been designated in central and northern Arizona in Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai counties. Critical habitat for the Southwestern willow flycatcher has been designated in Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai counties (Figure 3.1.6-3). FirstNet would attempt to avoid areas where this species is known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other five federally listed bird species in Oregon; 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

Designated critical habitat for the desert tortoise and Chiricahua leopard frog occurs in portions of Greenlee, Graham, Apache, La Paz, Mohave, Yavapai, Navajo, Gila, Coconino, Cochise, Santa Cruz, Pima, and Pinal counties. Land clearing, excavation activities, and other ground disturbing activities in these regions of Arizona could lead to habitat loss or degradation, which could lead to effects to these species depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Fish

Of the 13 endangered and 6 threatened known or believed to occur in Arizona, 14 have designated critical habitat that occurs throughout Arizona (Table 3.1.6-6). Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water, and therefore would not likely disturb critical habitat. FirstNet would attempt to avoid areas where these species would 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 9, 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 Arizona; 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

Designated critical habitat for the San Bernardino springsnail and the Three Forks springsnail occur in small portions of Cochise and Apache counties (Table 3.1.6-7). Land clearing, excavation activities, and other ground disturbing activities in these regions of Arizona could lead to habitat loss or degradation, which could lead affect these species depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Plants

Five of the federally listed plant species in Arizona have federally designated critical habitat. Designated critical habitat for the Gierisch mallow, Holmgren milk-vetch, Huachuca water-umbel, San Francisco Peaks Ragwort, and Navajo sedge occurs in northwestern and southeastern Arizona (Table 3.1.6-8). Land clearing, excavation activities, and other ground disturbing activities in these regions of Arizona could lead to habitat loss or degradation, which could affect these species depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other federally listed plant species in Arizona; therefore, no effect to these species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Alternative.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential effects to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Activities Likely to Have No Effect</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 on threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, 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 have no effect on threatened and endangered species because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are

already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have no impact on protected species.

Activities with the Potential to Affect Listed Species

Potential deployment-related effects to threatened and endangered species and their habitats as a result of implementation of the Preferred Alternative would encompass a range of effects that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects

  New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential effects to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (e.g., ground-nesting birds). Disturbance, including noise, associated with the above activities could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat if BMPs and mitigation measures are not implemented.

  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential effects to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.

  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in reproductive effects or behavior changes.

  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water and construction of landings and/or facilities on the shores or the banks of waterbodies that accept submarine cables could potentially affect threatened and endangered species and their habitat, particularly aquatic species (see Section 3.2.4, 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 RF emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, effects would be similar to new wireless construction. Hazards related to security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of 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 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 where these species are known to occur. Therefore, potential impacts may affect, but are not likely adversely affect protected species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, may affect, but are not likely to adversely affect threatened and endangered species, as they would be conducted infrequently, and BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. FirstNet would attempt to avoid areas where these species are known to occur. Therefore, listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

The following section assesses potential effects to threatened and endangered species associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential effects to threatened and endangered species as a result of implementation of this Alternative could be as described below.

<u>Deployment Impacts</u>

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

<u>Operational Impacts</u>

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that operational activities are not likely to adversely effect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid areas where these species would 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 9, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effects to threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.6, Threatened and Endangered Species and Species of Concern.

3.2.7. Land Use, Recreation, and Airspace

3.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Arizona associated with deployment and operation of the Proposed Action and Alternatives. Chapter 9, 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.

3.2.7.2. 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 3.2.7-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

Table 3.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less Than Significant with Mitigation Incorporated**	**Less Than Significant**	**No Impact**
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal changes in existing land use, or change that is permitted by-right, through variance, or through special exception.	No changes to existing development, land use, land use plans, or policies. No conversion of prime or unique agricultural lands.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA
Indirect land use change	Magnitude or Intensity	New land use directly conflicts with surrounding land use pattern, and/or causes substantial restriction of land use options for surrounding land uses.	Effect that is potentially significant, but with mitigation is less than significant.	New land use differs from, but is not inconsistent with, surrounding land use pattern; minimal restriction of land use options for surrounding land uses.	No conflicts with adjacent existing or planned land uses.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Land use altered indefinitely.		Short-Term: Land use altered for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation Incorporated	Less Than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is potentially significant, but with mitigation is less than significant.	Restricted access to recreation land or activities	No disruption or loss of access to recreational lands or activities.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Loss of enjoyment of public or private recreation land (due to visual, noise, or other impacts that make recreational activity less desirable)	Magnitude or Intensity	Total loss of enjoyment of recreational activities; substantial reduction in the factors that contribute to the value of the recreational resource, resulting in avoidance of activity at one or more sites.	Effect that is potentially significant, but with mitigation is less than significant.	Small reductions in visitation or duration of recreational activity.	No loss of enjoyment of recreational activities or areas; no change to factors that contribute to the value of the resource.
	Geographic Extent	Most or all recreational land/sites in a state or territory; recreational lands/sites that are of national significance.		Effects realized at one or multiple isolated locations; recreational lands that are not nationally significant, but that are significant within the state/territory.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation Incorporated	Less Than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is potentially significant, but with mitigation is less than significant.	Alteration to airspace usage is minimal.	No alterations in airspace usage or flight patterns.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Airspace altered indefinitely.		Short-Term: Airspace altered for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

3.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with exiting development or land use. The installation of poles, towers, structures, or other above-ground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the right-of-way, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 3.2.7-1 less than significant impacts would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would be obtained; only short-term impacts during the construction phase would be expected.

Indirect Land Use Change

Changes in surrounding land use patterns and options for surrounding land uses could be influenced by the deployment, operation, and maintenance of facilities and the acquisition of rights-of-way or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as any new land use would be small-scale; only short-term impacts during the construction phase would be expected.

Loss of Access to Public or Private Recreation Land or Activities

The deployment, operation, and maintenance of facilities and the acquisition of ROW or easement could influence access to public or private recreation land or activities. Localized, short-term accessibility to recreation land or activities could be impacted by the deployment and maintenance of structures, towers, roads, and other permanent features. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. 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 3.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drone, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period of time, FirstNet would not have a significant impact on airspace resources.

3.2.7.4. 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, Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure, and the specific deployment requirements, some activities would result in potential impacts to 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 9, BMPs and Mitigation Measures, provides a listing 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to land use, recreation, and airspace resources under the conditions described below:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - <u>Land Use</u>: See *Activities with the Potential to Have Impacts* below.
    - <u>Recreation</u>: See *Activities with the Potential to Have Impacts* below.
    - <u>Airspace</u>: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 3.1.7.5 Obstructions to Airspace Considerations).
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
    - <u>Land Use</u>: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - <u>Recreation</u>: See *Activities with the Potential to Have Impacts* below.
    - <u>Airspace</u>: It is anticipated that there would be no impacts to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*. (See Section 3.1.7.5 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* below.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
    - Airspace: No impacts are anticipated to airspace from collocation.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts on airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
    - Land Use: See *Activities with the Potential to Have Impacts* below.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact 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 3.1.7.5 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* below.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace*.
- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See *Activities with the Potential to Have Impacts* below.
    - Airspace: See *Activities with the Potential to Have Impacts* below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 3.1.7.5, Obstructions to Airspace Considerations.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact land use, recreation, and airspace, it is anticipated that this activities would have no impact on land use, recreation, and airspace.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road rights-of-way.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations.
    - Recreation: It is anticipated that plowing, trenching, or directional boring may cause temporary, localized restrictions to recreational land or activities, which may persist during the deployment phase. It is reasonable to anticipate that small reductions in visitation to localized areas may occur during the deployment phase.
    - Airspace: No impacts are anticipated – see previous section.
  - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
    - Land Use: These activities could result in term potential impacts to land uses. Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New structures, poles, or access roads on previously

undisturbed ROWs or easements could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new structures with existing and surrounding land uses.

    - Recreation: Deployment activities may cause temporary, localized restricted access to recreation land or activities, which may persist for the duration of the deployment phase. Small reductions to visitation during the deployment phase may be anticipated.
    - Airspace: No impacts are anticipated – see previous section.
  - New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore or inland bodies of water and the construction of 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 or inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
    - Airspace: No impacts are anticipated – see previous section.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
    - Airspace: No impacts are anticipated – see previous section.
- Wireless Projects
  - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access

roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.

- Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
- Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets other criteria. 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 Arizona’s airports.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower.
  - Land Use: No impacts are anticipated – see previous section.
  - Recreation: Installation of antennas or microwaves to existing towers may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
  - Airspace: Collocation of mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, addition of power units, structural hardening, and physical security measures could result in impacts if located near airports or air navigation facilities.

- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: No impacts are anticipated – see previous section.
    - Recreation: No impacts are anticipated – see previous section.
    - Airspace: Implementation of deployable aerial communications architecture could result in temporary or intermittent impacts to airspace. Deployment of tethered systems (such as balloons or blimps) could pose an obstruction hazard if deployed above 200 feet and near Arizona airports. Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.).

Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: No impacts are anticipated – see previous section.
    - Recreation: It is anticipated the installation of equipment on existing structures may cause temporary, localized restricted access to recreation lands or activities during installation, which may cause small reductions in visitation for the duration of installation.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology may impact airspace if equipment creates an obstruction.

In general, the abovementioned activities could potentially involve construction activities. Potential impacts to land uses associated with deployment of this infrastructure could include temporary restrictions to existing and surrounding land uses in isolated locations. Potential impacts to recreation land and activities could include temporary, localized restricted access and reductions in visitation or duration of recreational activities. Potential impacts to airspace could include obstructions. These potential impacts are expected to be less than significant 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above.

Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. 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 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 3.2.8, 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 9, 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.

3.2.7.5. 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.[178]

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have an imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities

[178] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

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 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this Alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be less than significant due to the temporary nature of deployment activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 3.1.7, Land Use, Recreation, and Airspace.

3.2.8. Visual Resources

3.2.8.1. Introduction

This section describes potential impacts to visual resources in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 3.2.8-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 3.2.8-1: Impact Significance Rating Criteria for Visual Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is potentially significant, but with mitigation is less than significant.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is potentially significant, but with mitigation is less than significant.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

NA = Not Applicable

3.2.8.3. 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 Arizona, residents and visitors travel to many national monuments, historic sites, and national and state parks to view its scenic vistas, cultural resources, and for recreational activities. 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 3.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered potentially significant if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. Given the small-scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects could be considered potentially significant.

Based on the impact significance criteria presented in Table 3.2.8-1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term would be considered potentially significant. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience potentially significant impacts to night skies, although potentially minimized to less than significant with implementation of BMPs and mitigation measures, as defined in Chapter 9, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

3.2.8.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to visual resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 9, BMPs and Mitigation Measures, provides a listing 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to visual resources under the conditions described below:

- Wired Projects
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts on visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public rights-of-ways would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact visual resources. However, impacts to the aesthetic character of scenic resources or viewsheds could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area.

If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources. However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lightning.

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 potential impacts are expected to be less than significant, due to the temporary and small-scale nature of the deployment activities. As discussed above, potential impacts to night skies are expected to be less than significant with BMPs and mitigation measures incorporated. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be less than significant with BMPs and mitigation measures incorporated during operations. Additionally, FirstNet would work closely with the NPS to address any concerns they might have if a tower needed to be placed in an area that might affect the nighttime sky at a NPS unit. Chapter 9, 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.

3.2.8.5. 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 as generally they would be limited to the deployment location and could often be screened or otherwise blocked from view. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be less than significant given the limited geographic scope for individual activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to visual resources as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.8, Visual Resources.

3.2.9. Socioeconomics

3.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 3.2.9-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts.

Table 3.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Incorporated**	**Less than Significant**	**No Impact**
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible economic change.	No change to spending, income, industries, and public revenues.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is potentially significant, but with mitigation is less than significant.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

3.2.9.3. 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 considerably across Arizona. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $254,000 in the greater Flagstaff area, to under $110,000 in the Casa Grande 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 radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and partners make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet 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 gains would be considered positive and less than significant. However, even small employment games are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary considerably across Arizona. The average unemployment rate in 2014 was 6.8 percent, higher than the national rate of 6.2 percent. Only two counties around the Phoenix/Mesa, Avondale/Goodyear, and Tucson areas had unemployment rates below the national average (that is, better employment performance). The remainder of the state had unemployment rates above the national average.

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 3.2.9-1 because they would not constitute a "high level of job creation at the state or territory level."

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

3.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 3.2.9-1. Chapter 9, BMPs and Mitigation Measures, provides a listing 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

- 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 on socioeconomic resources.

Activities with the Potential to Have Impacts

Potential impacts to socioeconomics for the Preferred Alternative would encompass a range of impacts that could result from deployment activities. The discussion below summarizes how the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:

    - Changes to Spending, Income, Industries, and Public Revenues– Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these project would generate temporarily a less than significant number of jobs regionally and statewide.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:

        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
        - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be less than significant.
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
    - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small number of sites within the region and state. Therefore, these impacts would be less than significant.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts.
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts. 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. 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 (the literature is not clear on this subject), 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, as described above. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Activities with the Potential to Have Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. As with deployment activities, all operational activities would have socioeconomic impacts, because all represent economic activity. Public or private sector employees would conduct all operational activities, and therefore support employment and involve payment of wages. Even if these economic effects are a very small for each operational activity, and not significant across the entire state, they are measurable socioeconomic impacts.

Potential socioeconomic impacts would primarily be beneficial, and generally of these types:

- Changes to Spending, Income, Industries, and Public Revenues – Operational activities would require expenditures, which then generate business income and employee wages, and may result in new public sector revenues such as taxes on sales and income. All such effects would be small in scale relative to the regional and state economy; their impacts would be less than significant.
- Impacts to Employment – Public and private sector organizations responsible for operating the NPSBN would sustain existing employees and/or hire new employees to carry out operational activities. They would generate a less than significant number of jobs regionally and statewide.

The potential negative impacts on property values mentioned above for deployment of new wireless communication towers and deployable technology storage, staging, and launch/landing areas may also apply in the operations phase. The ongoing presence of such facilities has aesthetic and other effects that may reduce nearby property values, relative to values in the absence of such facilities. These impacts, if they occur, would be less than significant as they would occur within a limited distance of each site, and would be limited to a relatively small number of sites within Arizona. Chapter 9, 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.

3.2.9.5. 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.

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 as described above. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

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 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 as they would be limited to a relatively small number of sites within the Arizona. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to socioeconomics from deployment and operation of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 3.1.9, Socioeconomics.

3.2.10. Environmental Justice

3.2.10.1. Introduction

This section describes potential impacts to environmental justice in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 3.2.10-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 3.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

3.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment" (CEQ, 1997). Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). See 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. Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 3.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier off the methodology and results of this PEIS. As discussed in Affected Environment (Section 3.1.10), Arizona's population has lower percentages of minorities than the region and higher percentages than the nation, and considerably higher rates of poverty than the region and the nation. A high proportion of Arizona has high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state. Further analysis using the data developed for the screening analysis in Section 3.1.10 may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2015p; USEPA, 2016b).

A 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" 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.

3.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 9, BMPs and Mitigation Measures, provides a listing 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to environmental justice under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would be through existing hand holes, pulling vaults, junction boxes, huts, and POP structures. Activities at these small entry points would be limited and temporary and thus are not likely to produce perceptible changes affecting any surrounding communities. Therefore, they would not affect environmental justice communities.

  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and therefore would have no impacts on environmental justice. If physical access 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 construction; impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, it is anticipated that this activity would have no impact on environmental justice.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would not impact environmental justice because there would be no ground disturbance or other impacts associated with this activity that would adversely impact communities. Associated onshore activities occurring at existing facilities such as staging of equipment and materials, or connection of cables, would be small in scale and temporary; thus, they would not impact environmental justice communities. Construction of new landings and/or facilities onshore to accept submarine

cable could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no adverse impacts on surrounding communities, and thus no potential for environmental justice impacts. Installation of optical transmission equipment or centralized transmission equipment requiring construction of new utility poles, hand holes, pulling vaults, junction boxes, huts, and POP structures could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads requires construction activities that could temporarily generate noise and dust, or disrupt traffic. New communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility. This activity would be small in scale, temporary, and highly unlikely to produce adverse human health or environmental impacts on the surrounding community. Thus, it would not impact environmental justice communities. If collocation requires construction for additional power units, structural hardening, and physical security measures, the construction activity could temporarily generate noise and dust and disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
    - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch and landing areas. To the extent such areas require new construction, noise and dust could be temporarily generated, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.

In general, the impacts from the abovementioned activities would be short-term and could potentially involve objectionable dust, noise, traffic, or other localized impacts due to construction activities. In some cases, these effects and aesthetic effects could potentially impact property values, particularly from new towers. These impacts are expected to be less than significant, but are problematic from an environmental justice perspective if they occur disproportionately in environmental justice communities. Since environmental justice impacts occur at the site-specific level, analyses of individual proposed projects would help determine potential impacts to specific environmental justice communities. BMPs and mitigation measures may be required to address potential impacts to environmental justice communities at the site-specific level. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction.

Impacts are expected to be less than significant given the short-term nature and limited geographic scope for individual activities. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.10.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to environmental justice communities resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, could require storage, staging, and launch/landing areas. To the extent such areas require new construction, noise and dust could be generated temporarily, and traffic could be disrupted. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant because they would be temporary in nature. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant as operations are expected to be temporary in nature. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 3.1.10, Environmental Justice.

3.2.11. Cultural Resources

3.2.11.1. Introduction

This section describes potential impacts to cultural resources in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.11.2. 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 3.2.11-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 3.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse effect	Mitigated adverse effect[a]	Effect, but not adverse	No effect
Physical damage to and/or destruction of historic properties[b]	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
	Geographic Extent	Direct effects APE.		Direct effects APE.	Direct effects APE.
	Duration or Frequency	Permanent direct effects to a contributing portion of a single or many historic properties.		Permanent direct effects to a non-contributing portion of a single or many historic properties.	No direct effects to historic properties.
Indirect effects to historic properties (i.e., visual, noise, vibration, atmospheric)	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a contributing or non-contributing portion of a single or many historic properties.	No indirect effects to historic properties.
	Geographic Extent	Indirect effects APE.		Indirect effects APE.	Indirect effects APE.
	Duration or Frequency	Long-term or permanent indirect effects to a single or many historic properties.		Infrequent, temporary, or short- or long-term or permanent indirect effects to a single or many historic properties.	No indirect effects to historic properties.
Loss of character defining attributes of historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No direct or indirect effects to historic properties.
	Geographic Extent	Direct and/or indirect effects APE.		Direct and/or indirect effects APE.	Direct and/or indirect effects APE.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse effect	**Mitigated adverse effect[a]**	**Effect, but not adverse**	**No effect**
	Duration or Frequency	Long-term or permanent loss of character defining attributes of a single or many historic properties.		Infrequent, temporary, or short-term changes to character defining attributes of a single or many historic properties.	No direct or indirect effects to historic properties.
Loss of access to historic properties	Magnitude or Intensity	Effects to a contributing portion of a single or many historic properties.	Adverse effect that has been procedurally mitigated through Section 106 process.	Effects to a non-contributing portion of a single or many historic properties.	No segregation or loss of access to historic properties.
	Geographic Extent	Any area surrounding historic properties that would cause segregation or loss of access to a single or many historic properties.		Any area surrounding historic properties that could cause segregation or loss of access to a single or many historic properties.	No segregation or loss of access to historic properties.
	Duration or Frequency	Long-term or permanent segregation or loss of access to a single or many historic properties.		Infrequent, temporary, or short-term changes in access to a single or many historic properties.	No segregation or loss of access to historic properties.

[a] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian Tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[b] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian Tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

3.2.11.3. 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 3.2.11-1, direct deployment impacts could be potentially significant if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Arizona, some deployment activities may be in these areas, in which case BMPs (see Chapter 9) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs and mitigation measures, as practicable or feasible (see Chapter 9).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to American Indians. It is anticipated that FirstNet would identify potential impacts to such areas through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

3.2.11.4. *Potential Impacts of the Preferred Alternative*

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

Deployment Impacts

As described in Section 2.1, Proposed Action, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 9, BMPs and Mitigation Measures, provides a listing 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

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 Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure 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 shorelines and creek banks in Arizona have the potential to contain prehistoric archaeological sites. Impacts to cultural resources could also potentially occur as a result of the construction of landings and/or facilities on shores or banks of waterbodies that accept submarine cable, which could result in the disturbance of archaeological and historical sites (archaeological deposits are frequently associated with bodies of water), 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 the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas that have larger numbers of historic public buildings.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could affect, but not adversely affect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment sites. 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no effect to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could affect but would not likely adversely affect, cultural resources. In the event that maintenance and inspection activities occur off existing roads, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 9, 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.

3.2.11.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse effects to historic properties associated with implementation/running of the deployable technology. No adverse effects would be expected to either site access or viewsheds due to the temporary nature of expected activities. As with the Preferred Alternative, it is anticipated that there would be no effects to cultural resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, impacts to archaeological sites could occur, however, in the event that this is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.11, Cultural Resources.

3.2.12. Air Quality

3.2.12.1. Introduction

This section describes potential impacts to Arizona's air quality from deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Arizona's air quality were evaluated using the significance criteria presented in Table 3.2.12-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact. Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to Arizona's air quality addressed in this section are presented as a range of possible impacts.

Table 3.2.12-1: Impact Significance Rating Criteria for Arizona

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Incorporated**	**Less than Significant**	**No Impact**
Increased air emissions	Magnitude or Intensity	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are *de minimis* or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term		Short term	Temporary

NA = Not Applicable

3.2.12.3. Description of Environmental Concerns

Increased Air Emissions

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be less than significant due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Arizona that are in maintenance or nonattainment for one or more criteria pollutants, particularly, PM and SO_2 are state-wide issues (see Section 3.1.12, Air Quality). The majority of the counties in Arizona are designated as maintenance areas for one or more of the following pollutants: PM, SO_2, and ozone (Figure 3.1.12-1); counties located in the southern portion of the state are designated nonattainment or maintenance for two NAAQS pollutants (Figure 3.1.12-1).

Based on the significance criteria presented in Table 3.2.12-1, air emissions impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in Arizona; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Arizona (Figure 3.1.12-1), FirstNet would try to minimize potential emissions where possible and would recommend the implementation of BMPs, where feasible and practicable, to avoid or minimize potential impacts.

3.2.12.4. Potential Impacts of the Preferred Alternative

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

Deployment and Operation Impacts

As described in Section 2.1, Proposed Action, 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 9, BMPs and Mitigation Measures, provides a listing 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

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to air quality under the conditions described below:

- Wired Projects
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points, however this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
    - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- Satellites and Other Technologies
    - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with Potential Impacts to Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shore to accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If 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 due to the limited nature of the deployment. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of 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 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 as they would still be limited in nature. Chapter 9, 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.

3.2.12.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The 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, given that these activities are of low-intensity and short duration. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

3.2.13. Noise

3.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and alternatives in Arizona. Chapter 9, 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.

3.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 3.2.13-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential noise impacts to Arizona addressed in this section are presented as a range of possible impacts.

Table 3.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than significant with BMPs and Mitigation Measures incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short term.	Temporary

3.2.13.3. Description of Environmental Concerns

Increased Noise Levels

The Proposed Action has the potential to generate noise during construction and operation of various equipment used for deployment. These noise levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise could cause impacts on residential areas, or other facilities that are sensitive to noise, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 3.1.13, Noise).

Based on the significance criteria presented in Table 3.2.13-1, noise impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise sources be deployed/operated long-term in the same area. Noise levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise-sensitive receptors. However, given that much of the concentration and setup of equipment would often occur in populated areas, FirstNet operations would not be able to completely avoid noise impacts due to construction and operations at various receptors.

3.2.13.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not. In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. Chapter 9, 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.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise impacts under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.

  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increased noise levels from the use of heavy equipment and machinery.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate noise if vessels are used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable could result in short-term and temporarily increased noise levels to local residents and other noise sensitive receptors from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Noise associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the noise emissions from optical networks are relatively low. Heavy equipment used to grade and construct access roads could generate increased levels of noise over baseline levels temporarily.
- Wireless Projects
  - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in localized construction noise. Operating vehicles, other heavy equipment, and generators would be used on a short-term basis and could increase noise levels.
  - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, or to grade or excavate additional land on sites for installation of equipment, such as antennas or microwave dishes on an existing tower, could impact the local noise environment temporarily.
  - Deployable Technologies: The type of deployable technology used would dictate the types of noise generated. For example, mobile equipment deployed via heavy trucks could generate noise from the internal combustion engines associated with the vehicles and onboard generators. With the exception of balloons, aerial platforms (e.g., UASs or other aircraft, except balloons) generate noise during all phases of flight, including

takeoff, landing, and flight operations over necessary areas that could impact the local noise environment.

In general, noise from the abovementioned activities would be products of site preparation, installation, and construction activities, as well as additional construction vehicles traveling on nearby roads and localized generator use. These impacts are expected to be less than significant due to the temporary duration of deployment activities. Additionally, pre-existing noise levels achieved after some months (typically less than a year but could be a few hours for linear activities such as pole construction). Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant and similar to several of the deployment activities related to routine maintenance and inspection of the facilities because of the temporary nature of the activities which would not create new permanent sources of noise. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be similar to or less than those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections or onsite generator use occurs, potential noise impacts could result as explained above. Chapter 9, 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.

3.2.13.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows:

Deployment Impacts

Implementing deployable technologies could result in noise from mobile equipment deployed via heavy trucks, including not only onboard generators, but also the vehicles themselves. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may increase localized noise levels. Several vehicles traveling together could also create short-term noise impacts on residences or other noise-sensitive receptors as they pass by. With the exception of balloons, the deployment of aerial technology is anticipated to generate noise during all phases of flight. Aerial technologies would have the highest level of noise impact if they are required to fly above residential areas, areas with a high concentration of noise-sensitive receptors (i.e., schools or churches), or over national parks or other areas where there is an expectation of quiet and serenity on their way to their final destinations. Residences near deployment areas for aerial technologies (i.e., airports or smaller airfields) could also be affected during takeoff and landing operations. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise impacts would be the same as those described for the deployment activities. If usage of vehicles or heavy equipment as part of routine maintenance or inspections occurs, potential noise impacts could result as explained above.

Operational impacts from aerial technologies would include repeated flyovers by UAS vehicles while they are needed in the area. This could generate less than significant short-term impacts on any residential areas or other noise-sensitive receptors under the flight path of these vehicles. However, once these operations cease, noise levels would quickly return to baseline levels. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

3.2.14. Climate Change

3.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Arizona associated with deployment and operation of the Proposed Action and alternatives. Chapter 9, 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.

3.2.14.2. 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 3.2.14-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to climate and climate change-vulnerable resources addressed in this section are presented as a range of possible impacts.

CEQ requires the consideration of climate change from two perspectives. The first is the potential for impacts on climate change through GHG emissions resulting from the Proposed Action or alternatives. The second is related to the implications and possible effects of climate change on the environmental consequences of the Proposed Action or alternatives. This extends to the impacts of climate change on facilities and infrastructure that would be part of the Proposed Action or Alternatives (CEQ, 2014).

CEQ has established the significance criteria for GHG emissions at 25,000 MT CO_2e on an annual basis, with the requirement that if projected emissions exceed this threshold, a GHG emissions quantitative analysis is warranted (CEQ, 2014). Although 25,000 MT is a very small fraction (one 266,920th) of the total U.S. emissions of 6,673 MMT CO_2e in 2013 (USEPA, 2015q), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO_2 and other GHGs from other projects and human activities, could be significant.

CEQ guidance for the consideration of effects of climate change on the environmental consequences of the proposed action is more general. In addition to the consideration of climate change's effects on environmental consequences, it also includes the impact that climate change may have on the projects themselves (CEQ, 2014). Projects located in areas that are vulnerable to the effects of climate change (e.g., sea level rise) may be at risk. Analysis of these risks through the NEPA process could provide useful information to the project planning to ensure these projects are resilient to the impacts of climate change.

Table 3.2.14-1: Impact Significance Rating Criteria for Climate Change

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
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

3.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. The Southwest is the hottest and driest region in the United States, and the region is already experiencing impacts from climate change. The decade 2001-2010 was the warmest in the 110-year instrumental historical record keeping, with temperatures almost 2 °F higher than historic averages, which included fewer cold air outbreaks and more heat waves. Summertime heat waves are projected to become longer and hotter, whereas the trend of decreasing wintertime cold air outbreaks is projected to continue. These changes will directly affect urban public health and will also have direct impacts on crop yields. (USGCRP, 2014a)

Air Temperature

Figures 3.2.14-1 and 3.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Arizona from a 1969 to 1971 baseline.

Bsk – Figure 3.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Arizona under a low emissions scenario would increase by approximately 4 °F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the Bsk region of Arizona would increase by approximately 5 °F in the southern portion of the region and by 6 °F in the northern portion of the region. (USGCRP, 2009)

Figure 3.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Cfa region of Arizona, temperatures would increase by approximately 9 °F. (USGCRP, 2009)

Bsh – Temperatures in this region are expected to increase by 4 °F by mid-century under a low emissions scenario, and by 5 °F by the end of the century. (USGCRP, 2009)

Under a high emissions scenario, temperatures are projected to increase at the same rate as the Bsk region by mid-and-end of the century. (USGCRP, 2009)

Bwh – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Bsk region under a low emissions scenario. (USGCRP, 2009)

Under a high emissions scenario, the majority of the Bwh region temperatures would increase by approximately 5 °F by mid-century while a very small portion of the region is expected to have increases of 4 °F. By the end of the century under this scenario, temperatures in this region are expected to increase by 9 °F in the majority of the region while a small portion are expected to have increases of 8 °F. (USGCRP, 2009)

Csa – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Bsk region under both low and high emissions scenarios. (USGCRP, 2009)

Csb – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Bsh region under both low and high emissions scenarios. (USGCRP, 2009)

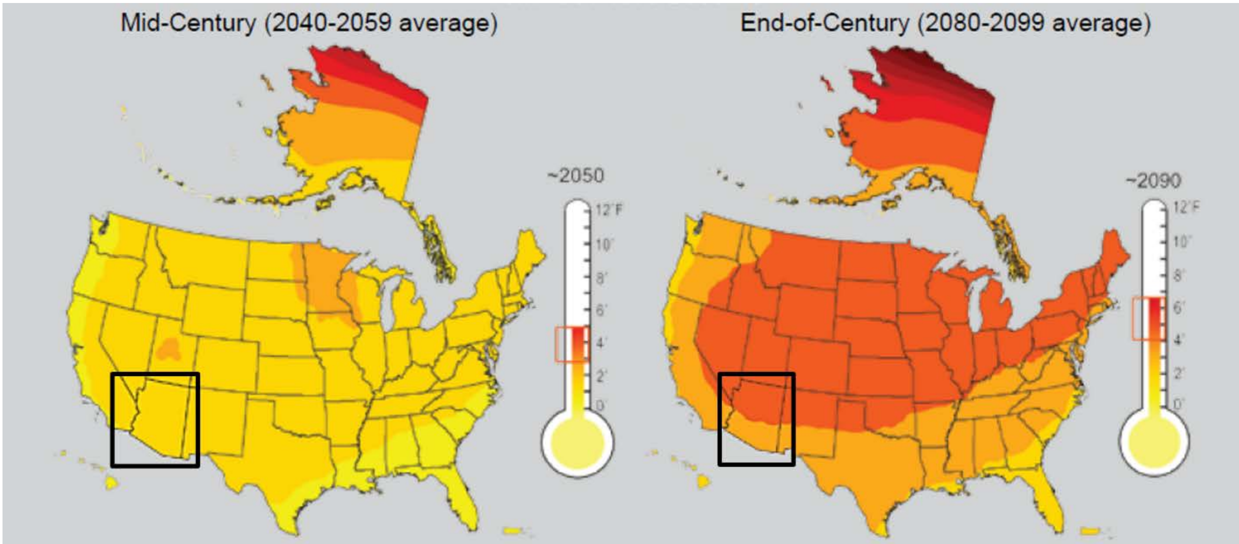


Figure 3.2.14-1: Arizona Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

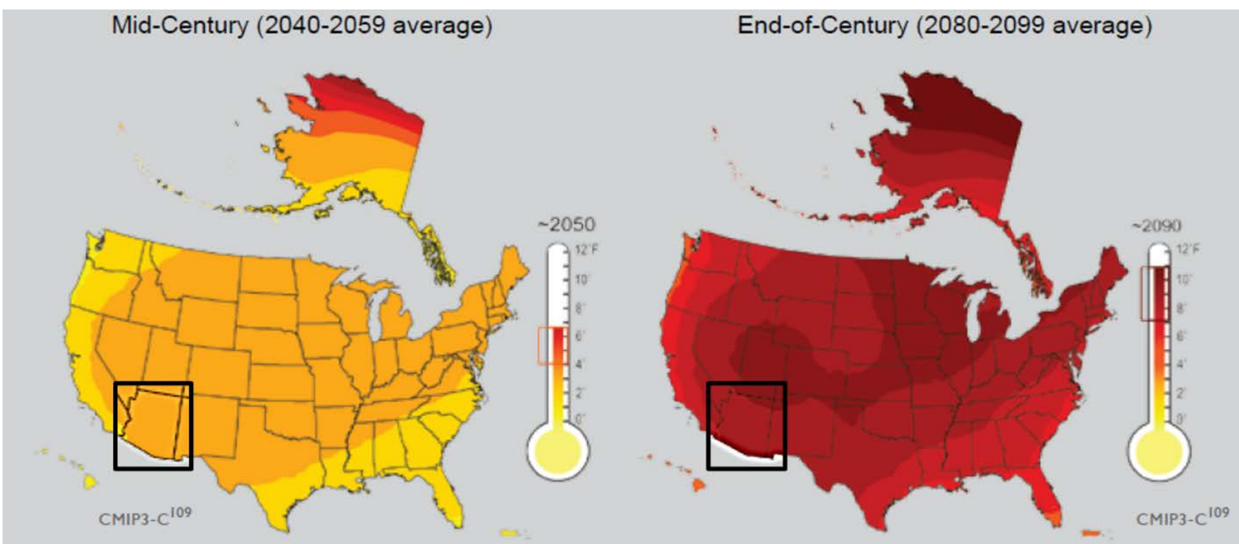


Figure 3.2.14-2: Arizona High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

Precipitation

Projections of precipitation changes are less certain than those for temperature. Under a high emissions scenario, reduced winter and spring precipitation is consistently projected for the southern part of the Southwest by 2100. In the northern part of the region, projected winter, spring, summer and fall precipitation changes are smaller than natural variations. The Southwest is prone to drought, and future droughts are projected to be substantially hotter, and for major river basins such as the Colorado River Basin, drought is projected to become more frequent, intense, and longer lasting. These drought conditions present a huge challenge for the management of water resource and natural hazards such as wildfire. (USGCRP, 2014a)

Total seasonal snowfall has generally decreased in southern and some western areas although snow is melting earlier in the year and more precipitation is falling as rain versus snow. Overall snow cover has decreased in the Northern Hemisphere, due in part to higher temperatures that shorten the time snow spends on the ground. (USGCRP, 2014c)

There is an expected increase in the number of consecutive dry days under a low and high emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000) throughout Arizona. An increase in consecutive dry days could lead to drought. (USGCRP, 2014b)

Figures 3.2.14-3 and 3.2.14-4 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 3.14.6-3 show 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 3.2.14-4 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 3.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation would decrease by 10 percent in winter in some areas of the Bsk region of Arizona while other areas are not expected to show changes in precipitation in winter. However, there are no expected increases in precipitation in spring, summer, or fall other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 3.2.14-4 shows that if emissions continue to increase, winter precipitation could increase 10 percent, remain constant, or decrease 10, 20, or 30 percent over the period 2071 to 2099 depending on the area of the Bsk region. In spring, precipitation in this scenario could decrease 10, 20, or 30 percent depending on the area of the region. Summer precipitation is expected to remain constant or increase 10 percent, and in the northwest corner of the state precipitation is expected to increase 20 percent. No significant change to fall precipitation is anticipated over the same period. (USGCRP, 2014b)

Bsh – Precipitation changes for the Bsh region under a low emissions scenario for spring, summer and fall are consistent with projected changes for the Bsk region. In winter, precipitation is expected to decrease by 10 percent for the Bsh region. (USGCRP, 2014b)

Under a high emissions scenario, winter precipitation is expected to decrease 10 percent in the Bsh region of Arizona. Spring precipitation is expected to decrease 30 percent. No significant change to summer or fall precipitation is expected under this scenario. (USGCRP, 2014b)

Bwh – Precipitation changes for the Bsh region under a low emissions scenario for spring, summer and fall are consistent with projected changes for the Bsk region. In winter, precipitation is expected to decrease by 10 percent in some areas of the Bwh region while in other areas there are no anticipated changes in precipitation. (USGCRP, 2014b)

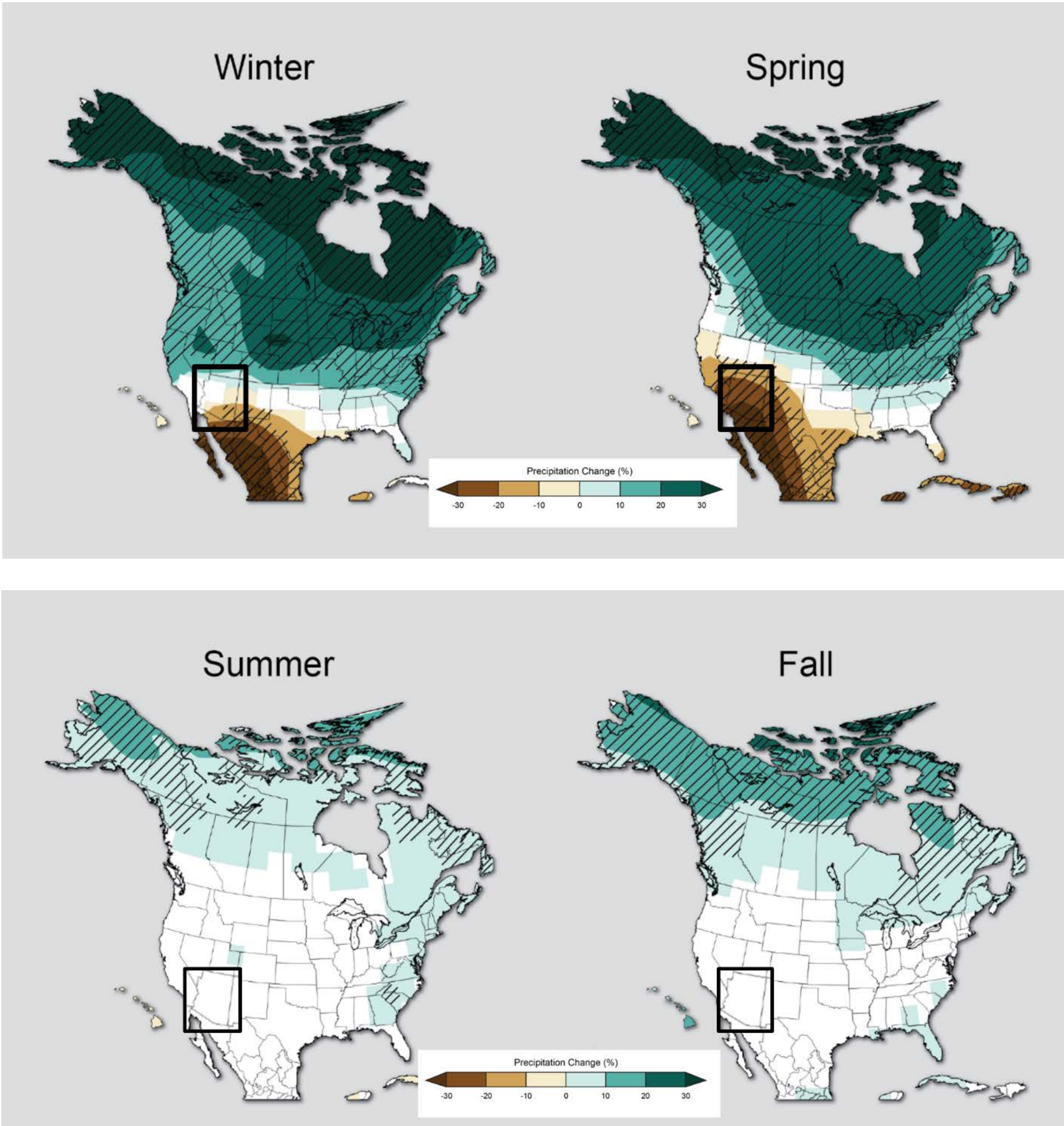
Under a high emissions scenario, winter precipitation is expected to decrease by 10 percent in some areas while in other areas of the region there are no anticipated changes in precipitation. Spring precipitation is expected to decrease 10, 20, or 30 percent depending on the portion of the region. In summer, precipitation is expected to remain constant, or increase 10 or 20 percent depending on the area. There are no expected changes to fall precipitation in the region under a high emissions scenario. (USGCRP, 2014b)

Csa – There are no anticipated changes in precipitation in winter, spring, summer, or fall in the Csa region of Arizona. (USGCRP, 2014b)

In winter and fall under a high emissions scenario there are no expected changes to precipitation in the Csa region. Spring precipitation is expected to decrease 10 percent and summer precipitation is expected to increase 10 percent in this scenario. (USGCRP, 2014b)

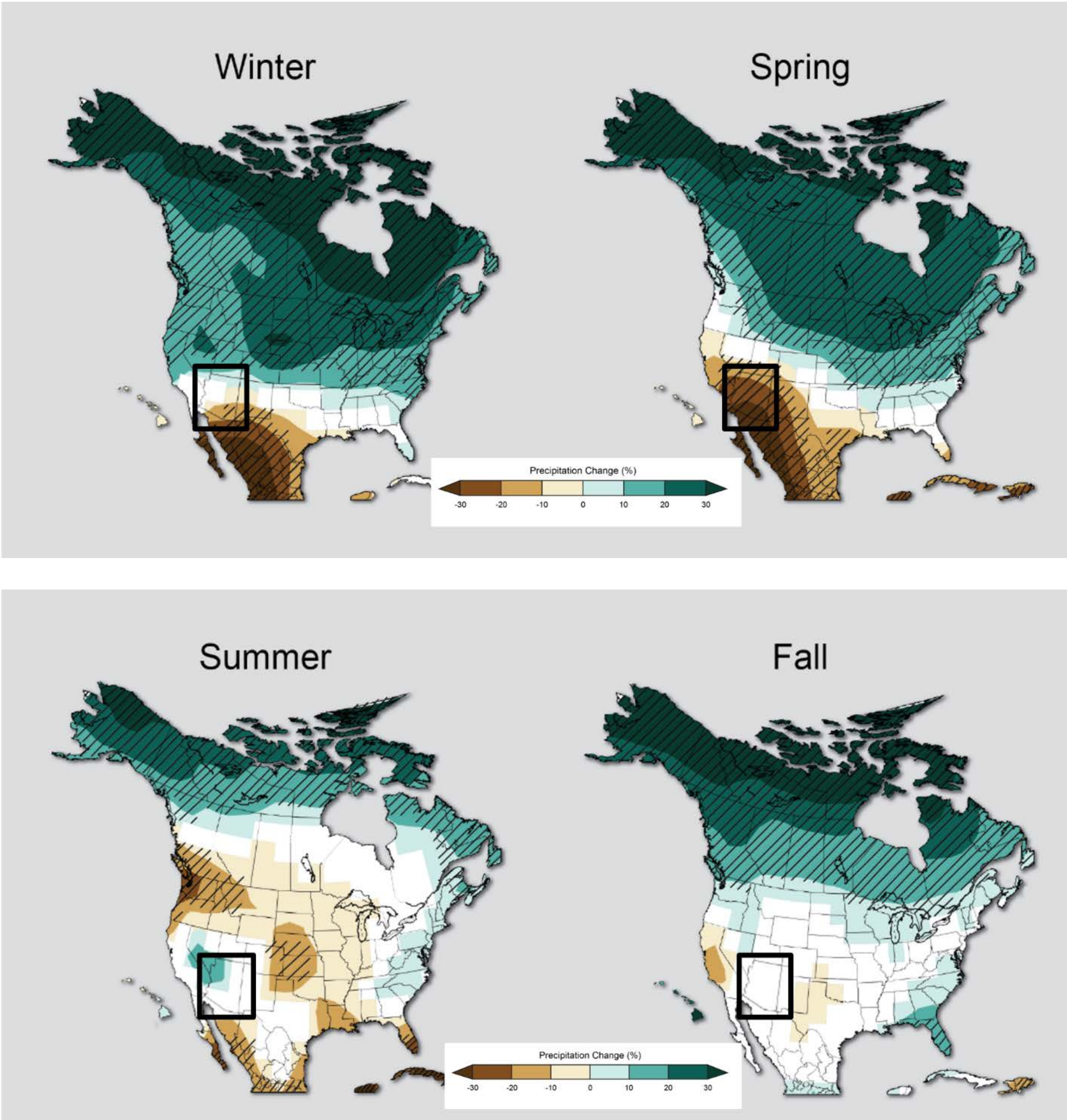
Csb – Precipitation changes for the Csb region under a low emissions scenario for spring, summer, and fall are consistent with projected changes for the Bsk, Bsh, and Csa regions. In winter, precipitation is expected to decrease 10 percent. (USGCRP, 2014b)

In winter and spring under a high emissions scenario precipitation is anticipated to decrease 20 percent. There are no significant changes expected in fall or summer precipitation in the Csb region of Arizona. (USGCRP, 2014b)



Source: (USGCRP, 2014b)

Figure 3.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014b)

Figure 3.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as winter storms and thunderstorms. Trends in thunderstorms are subject to greater uncertainties than trends in temperature and associated variables directly related to temperature such as sea level rise. Climate scientists are studying the influences of climate change on severe storms. Recent research has yielded insights into the connections between warming and factors that cause severe storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014c)

3.2.14.4. 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 3.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or 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.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015i). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO_2 per year.

However, grid-provided electricity would result in less CO_2 emissions than on-site provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015r), the same transmitter would be responsible for approximately 271 MT of CO_2 per year running continuously. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters

(Vereecken, et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Effects of Climate Change on Project-Related Impacts

Climate change may increase project-related impacts by magnifying or otherwise altering impacts in other resources areas. For example, climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. These impacts will be considered fully in Chapter 11, Cumulative Impacts. No BMPs will be described for this aspect of the resource.

The severity and length of droughts is expected to increase in Arizona as snow pack is reduced and temperatures rise. This in turn may contribute to more frequent and larger wildland fires (USGCRP, 2014d) as well as increased fuel load in the form of dead trees caused by invasive bark beetles (USFS, 2015d). Wildland fires may present a risk to both permanent and mobile installations as well as to first responders themselves, as well as impacting ecosystems. More frequent and persistent droughts could significantly impact Arizona's economy as western states compete for the same water resources (USEPA, 2015s).

Impact of Climate Change on FirstNet Installations and Infrastructure

Climate change impacts on FirstNet installations and infrastructure will vary from state to state, depending on the placement and vulnerability of the installations and infrastructure, and the impacts that climate change is anticipated to have in that particular location.

For areas of Arizona at risk for flooding, climate change is projected to increase the frequency and severity of torrential downpours which in turn may increase the potential for flash floods (USGCRP, 2014e) which could damage FirstNet installations or infrastructure.

Climate change may expose areas of Arizona increased intensity and duration of heat waves (USGCRP, 2014e) particularly in large population centers such as Phoenix with significant urban heat islands (Chow, Brennan, & Brazel, 2012) that could greatly magnify these effects. Extended periods of extreme heat in the Southwest may increase general demand on the electric grid, impede the operation of the grid (DOE, 2015), and overwhelm the capacity on-site equipment needed to keep microwave and other transmitters cool.

3.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

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

As described in Section 2.1, Proposed Action, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure development scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to climate change under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
  - Distribution of Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts

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 Projects
  - COWs, COLTs, or SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts in excess of 25,000 MT if operated in large numbers over the long-term. However, this would be highly dependent on their size, number, and the frequency and duration of their use.
  - Emissions associated with the deployment and maintenance of a complete network solution of this type may be significant if large numbers of piloted or unmanned aircraft were used for a sustained period of time (i.e., months to years). Emissions would depend

on the type of platforms used, their energy consumption, and the duration of the network's operation.

Potential climate change impacts associated with deployment activities as a result of implementation of the Preferred Alternative include increased GHG emissions. GHG emissions would arise from the combustion of fuel used by equipment during construction and changes in land use. Emissions occurring as a result of soil disturbance and loss of vegetation are expected to be less than significant due to the limited and localized nature of deployment activities. Chapter 9, 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.

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 because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact resulting to the project, including adaptation, which refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

3.2.14.6. 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 based on the defined significance criteria, since activities would be temporary and short-term. Chapter 9, 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.

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 due to the temporary nature of 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 due the limited duration of deployment activities. Chapter 9, 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.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

Climate change effects have the most noticeable impacts over a long period. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology due to the temporary nature of deployment. However, if these technologies are deployed continuously (at the required location) for an extended period, climate change effects on deployables could be similar to the Proposed Action, as explained above. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.14, Climate Change.

3.2.15. Human Health and Safety

3.2.15.1. Introduction

This section describes potential impacts to human health and safety in Arizona associated with deployment of the Proposed Action and alternatives. Chapter 9, 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.

3.2.15.2. 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 3.2.15-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts.

Table 3.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory)		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with Mitigation Incorporated**	**Less than Significant**	**No Impact**
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with Mitigation 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.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event	NA

NA = Not Applicable

3.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that are inherently dangerous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 3.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

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, 2015c).

- Engineering controls;
- Work practice controls;
- Administrative controls; and then
- 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,[179] 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

[179] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016d)

employer specific workplace rules and operational practices (OSHA, 2015c). 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, 2015c). 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 (e.g., earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure.

ADOSH is authorized by OSHA to administer the state program which oversees employee safety in all state and local government workplaces. The FirstNet proposed action and site work will not be performed by state or local employees. The involvement of state and local employees will be limited to emergency responders (e.g., police, fire, emergency medical transporters, etc.) and local government permitting authorities.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination and mine lands at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions because of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 3.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned or active mine lands. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned

Mine Lands inventory, through the Arizona State Department of Environmental Protection, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid know 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 Arizona state laws in order to protect works 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 the Arizona State Department of Environmental Protection 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 3.2.15-1, 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 9, 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.

3.2.15.4. 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 9, 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.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise impacts under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: The pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be no impacts to human health and safety.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would have no impacts on human health and safety because there would be no ground disturbance or heavy equipment used.
- Satellites and Other Technologies
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it 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 health and human safety resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to human health and safety as a result of implementation of the Preferred Alternative would encompass a range of impacts that occur as a result of ground disturbance activities, construction activities, equipment upgrade activities, management of hazardous materials and/or hazardous waste, and site selection. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to human health and safety include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain

environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road right-of-ways, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in 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 shore to accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and

management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- 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 not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human

health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of 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. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative. 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 exposure, and risk of infectious disease transmission would be less than significant due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 9, 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.

3.2.15.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage fuel onsite. These activities could result in less than significant impacts to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small-scale of likely FirstNet activities that would be temporary and of short duration. Chapter 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative. 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 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 9, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to human health and safety as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.2.15, Human Health and Safety.

ACRONYMS

Acronym	Definition
AAA	Arizona Antiquities Act
AAC	Arizona Administrative Code
AARC	Average Annual Rate of Change
ABOR	Arizona Board of Regents
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADA	Arizona Department of Agriculture
ADEQ	Arizona Department of Environmental Quality
ADOL	Arizona Department of Labor
ADOSH	Arizona Division of Occupational Safety and Health
AFB	Air Force Base
AFF	Army Airfield
AGL	Above Ground Level
AIRFA	American Indian Religious Freedom Act
AIRS	Arizona Interoperable Radio System
AMA	Active Management Area
AML	Abandoned Mine Lands
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ARS	Arizona Revised Statutes
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
AUM	Abandoned Uranium Mine
AZ	Arizona
AZCC	Arizona Corporation Commission
AZDEMA	Arizona’s Department of Emergency Management and Military Affairs
AZDHS	Arizona Department of Health Services
AZDOT	Arizona Department of Transportation
AZGFD	Arizona Game and Fish Department
AZPDES	Arizona Pollutant Discharge Elimination System
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CAA	Clean Air Act
CC&N	Certificate of Convenience and Necessity
CEQ	Council on Environmental Quality
CFOI	Census of Fatal Occupational Injuries
CGP	Construction General Permit
CH_4	Methane
CIMC	Cleanups in My Community
CMA	Cooperative Management Area
CO	Carbon Monoxide
CO_2	Carbon Dioxide

Acronym	Definition
CRS	Community Rating System
CWA	Clean Water Act
DISDI	Defense Installations Spatial Data Infrastructure
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right-to-Know Act
ESRI	Environmental Systems Research Institute
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FRPS	Flagstaff Regional Public Safety
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAP	Gap Analysis Program
GHG	Greenhouse Gas
GIO	Geospatial Information Officer
GNIS	Geographic Names Information System
HAP	Hazardous Air Pollutants
HASP	Health and Safety Plans
HDMS	Heritage Data Management System
HHRA	Human Health Risk Assessment
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LMR	Land Mobile Radio
LRR	Land Resource Region
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MCAQD	Maricopa County Air Quality Department
MCL	Maximum Contaminant Level
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MMT	Million Metric Tons
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
NCA	National Conservation Areas
NEPA	National Environmental Policy Act

Acronym	Definition
NFIP	National Flood Insurance Program
NHA	National Heritage Area
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NOTAM	Notices To Airmen
NO_X	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NTFI	National Task Force On Interoperability
NWI	National Wetlands Inventory
NWP	Nationwide Permit
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OTR	Ozone Transport Region
PCAQCD	Pinal County Air Quality Control District
PCWIN	Pima County Wireless Integrated Network
PDEQ	Pima County Department of Environmental Quality
PEP	Project Evaluation Program
PGA	Peak Ground Acceleration
PHX	Phoenix Sky Harbor International Airport
PPE	Personal Protective Equipment
PSCR	Public Safety Communications Research Program
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
RWC	Regional Wireless Cooperative
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SDS	Safety Data Sheets
SDWA	Safe Drinking Water Act
SF_6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SHPA	State Historic Preservation Act
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SO_X	Oxides of Sulfur
SPL	Sound Pressure Level
SUA	Special Use Airspace

Acronym	Definition
SWEMS	Statewide Emergency Mobile System
SWPP	Stormwater Pollution Prevention Plan
TEOM	Tapered Element Oscillating Microbalance
TMDL	Total Maximum Daily Load
TPC	The Players Championship
TPY	Tons Per Year
TRI	Toxics Release Inventory
TRWC	TOPAZ Regional Wireless Cooperative
TUS	Tucson International Airport
TWA	Time Weighted Average
UAS	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHR	Very High Frequency
VRP	Voluntary Remediation Program
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WQARF	Water Quality Assurance Revolving Fund
WWI	World War I
WWII	World War II
YRCS	Yuma Regional Communication System
YRWS	Yuma Regional Wireless System

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