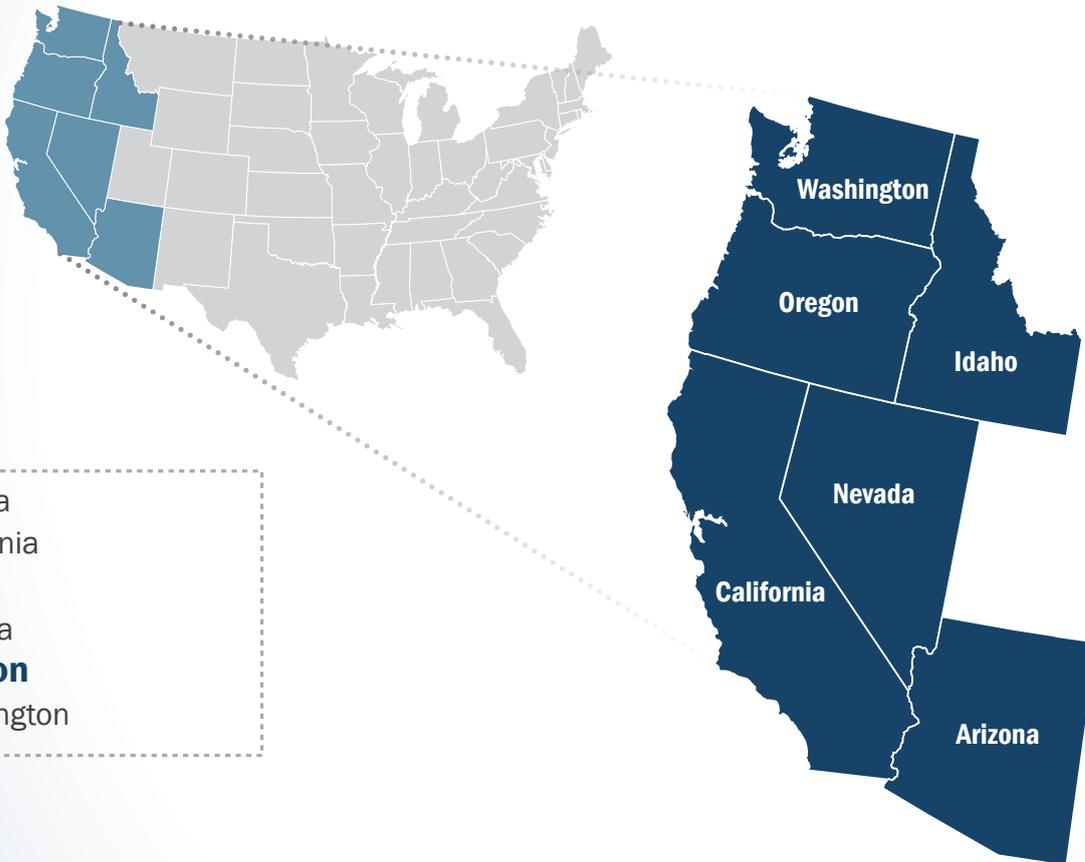




FirstNet[®]

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

VOLUME 5 - CHAPTER 7



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First Responder Network Authority



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

VOLUME 5 - CHAPTER 7

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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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7. OREGON

Oregon was populated for centuries by American Indians with a rich cultural history. In 1778, Captain James Cook made landfall in Oregon while searching for a northwestern passage through North America. Cook was soon followed by other English mariners who came to Oregon to obtain animal pelts (such as sea otter and beaver) for the fur trade. Lewis and Clark reached Oregon by an overland route in 1805. In the 1840s, American pioneers began migrating west by way of the Oregon Trail. In 1859, after spending a few years as a territory, Oregon gained statehood (Oregon Secretary of State, 2015b). Oregon is bordered by the Pacific Ocean to the west, California and Nevada to the south, Idaho to the east, and Washington to the north. This chapter provides details about the existing environment of Oregon as it relates to the Proposed Action.



General facts about Oregon are provided below:

- **State Nickname:** The Beaver State
- **Land Area:** 95,988 square miles; **U.S. Rank:** 10 (U.S. Census Bureau, 2015a)
- **Capital:** Salem
- **Counties:** 36 (U.S. Census Bureau, 2015b)
- **2015 Estimated Population:** 4,028,977; **U.S. Rank:** 27 (U.S. Census Bureau, 2015f)
- **Most Populated Cities:** Portland, Eugene, Salem, Medford, and Bend (U.S. Census Bureau, 2015b)
- **Main Rivers:** Columbia River, Deschutes River, Willamette River, John Day River, and Snake River
- **Bordering Waterbodies:** Columbia River, Snake River, and Pacific Ocean
- **Mountain Ranges:** Blue Mountains, Klamath Mountains, Wallowa Mountains, Steens Mountains, Cascade Range, and Coastal Range
- **Highest Point:** Mount Hood (11,237 feet) (USGS, 2015a)

7.1. AFFECTED ENVIRONMENT

7.1.1. Infrastructure

7.1.1.1. *Definition of the Resource*

This section provides information on key Oregon infrastructure resources that could potentially be affected by FirstNet Proposed Actions. Infrastructure consists of the systems and physical structures that enable a population in a specified area to function. Infrastructure is entirely manmade with a high correlation between the type and extent of infrastructure and the degree to which an area is characterized as “developed.” Infrastructure includes a broad array of facilities such as utility systems, streets and highways, railroads, airports, buildings and structures, ports, harbors and other manmade facilities. Individuals, businesses, government entities, and virtually all relationships between these groups depend on infrastructure for their most basic needs, as well as for critical and advanced needs (e.g., emergency response, health care, and telecommunications).

Section 7.1.1.3 provides an overview of the traffic and transportation infrastructure in Oregon, including road and rail networks and airport facilities. Oregon public safety infrastructure could include any infrastructure utilized by a public safety entity¹ as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 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 Oregon are presented in more detail in Section 7.1.1.4. Section 7.1.1.5 describes specific public safety communications infrastructure and commercial telecommunications infrastructure in Oregon. An overview of utilities in Oregon, such as power, water, and sewer, are presented in Section 7.1.1.6.

7.1.1.2. *Specific Regulatory Considerations*

Multiple Oregon laws and regulations pertain to the state’s public utility and transportation infrastructure and its public safety community. Table 7.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state’s applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

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

Table 7.1.1-1: Relevant Oregon Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
2015 Oregon Laws: Chapters 546, 566, 690, 712, 779, and 808; Oregon Revised Statutes: Volume 12 Drugs and Alcohol, Fire Protection, and Natural Resources	Oregon State Department of Fish and Wildlife (ODFW)	Regulates hunting and Fishing within the state to protect and enhance Oregon’s fish and wildlife and their habitats.
2015 Oregon Laws: Chapter 390; Oregon Revised Statutes: Volume 09 Education and Culture	Oregon Historical Society	Collect, preserve, and interpret documents and artifacts from the past; create opportunities for scholars to conduct research and share their work with the public; offer programs and services that educate and entertain students and the general public; and offer high quality museum, library, education, and publishing programs.
2015 Oregon Laws: Chapter 700; Oregon Revised Statutes: Volume 10 Highways, Military, Juvenile Code and Human Services	Office of Emergency Management	Coordinate and facilitate emergency planning, preparedness, response and recovery activities with the state and local emergency services agencies and organizations.
2015 Oregon Laws: Chapters 24, 231, 305, and 312; Oregon Revised Statutes: Volume 10 Highways, Military, Juvenile Code and Human Services	Public Utility Commission	Regulate customer rates and services of the state's investor-owned electric, natural gas and telephone utilities; and certain water companies; does not regulate people's utility districts, cooperatives or municipally-owned utilities except in matters of safety; ensures consumers receive utility service at fair and reasonable rates, while allowing regulated companies the opportunity to earn an adequate return on their investment.
2015 Oregon Laws: Chapters 8, 56, 138, 390, 761, and 820; Oregon Revised Statutes: Volume 10 Highways, Military, Juvenile Code and Human Services; Volume 17 Utilities, Vehicle Code, Watercraft, Aviation, and Constitutions	Department of Transportation	Provide a safe, efficient transportation system that supports economic opportunity and livable communities; and develop programs related to Oregon’s system of highways, roads, and bridges; railways; public transportation services; transportation safety programs; driver and vehicle licensing; and motor carrier regulation.
2015 Oregon Laws: Chapters 156, 233 and 780; Oregon Revised Statutes: Volume 13 Water Resources, Agriculture and Food	Water Resources Commission	Promote responsible water management; address Oregon's water supply needs; and restore and protect stream flows and watersheds in order to ensure the long-term sustainability of Oregon’s ecosystems, economy, and quality of life.

Sources: (Oregon Revised Statutes, 2013) (Oregon Laws, 2015) (ODFW, 2015a) (Oregon Historical Society, 2015) (Oregon Office of Emergency Management, 2015) (PUC, 2015d) (ODOT, 2015a) (Water Resources Commission, 2015)

7.1.1.3. Transportation

This section describes the traffic and transportation infrastructure in Oregon, including specific information related to the road networks, airport facilities, rail networks, ports, and harbors (this PEIS defines “harbor” as a body of water deep enough to allow anchorage of a ship or boat). The movement of vehicles is commonly referred to as traffic, as well as the circulation along roads. Roadways in the state can range from multilane road networks with asphalt surfaces, to

unpaved gravel or private roads. The information regarding existing transportation systems in Oregon are based on a review of maps, aerial photography, and federal and state data sources.

The Oregon Department of Transportation (ODOT) has jurisdiction over freeways and major roads, airports, railroads, and ports in the state; local counties have jurisdiction for smaller streets and roads. The ODOT’s mission is to “provide a safe, efficient transportation system that supports economic opportunity and livable communities for Oregonians” (ODOT, 2015b).

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

- 71,228 miles of public roads (FHWA, 2014a) and 8,052 bridges (FHWA, 2015a);
- 2,369 miles of rail network that includes passenger rail and freight (ODOT, 2014);
- 420 aviation facilities, including airstrips and heliports (FAA, 2015a);
- 29 major harbors (U.S. Harbors, 2015); and
- Four major ports (both public and private facilities).

Road Networks

As identified in Figure 7.1.1-1, the major urban centers of the state from north to south are Portland, Salem, Eugene, Bend, and Medford (U.S. Department of Commerce, 2013a). Oregon has three major interstates connecting its major metropolitan areas to one another, as well as to other states. Travel outside the major metropolitan areas is conducted on interstates, and state and county roads. Table 7.1.1-2 lists the interstates and their start/end points in Oregon. Per the national standard, even numbered interstates run from west to east with the lowest numbers beginning in the south; odd numbered interstates run from north to south with the lowest numbers beginning in the west (FHWA, 2015b).

Table 7.1.1-2: Oregon Interstates

Interstate	Southern or Western Terminus in Oregon	Northern or Eastern Terminus in Oregon
I-5	California line near Ashland	Washington line in Portland
I-82	I-84 near Hermiston	Washington line at Umatilla
I-84	I-5 in Portland	Idaho line at Ontario

In addition to the interstate system, Oregon 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 7.1.1-1 illustrates the major transportation networks, including roadways, in Oregon. Section 7.1.8, Visual Resources, describes the National and State Scenic Byways found in Oregon from an aesthetic perspective.

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

- Cascade Lakes Scenic Byway
- Hells Canyon Scenic Byway
- Historic Columbia River Highway
- McKenzie Pass-Santiam Pass Scenic Byway
- Mt. Hood Scenic Byway
- Outback Scenic Byway
- Pacific Coast Scenic Byway
- Rogue-Umpqua Scenic Byway
- Volcanic Legacy Scenic Byway
- West Cascades Scenic Byway

State Scenic Byways are roads with statewide interest; ODOT designates and manages six State Scenic Byways that crisscross the entire state (ODOT, 2015c):

- Blue Mountain Scenic Byway
- Elkhorn Scenic Byway
- High Desert Discovery Scenic Byway
- Journey Through Time Scenic Byway
- Over The Rivers and Through the Woods Scenic Byway
- Upqua Scenic Byway

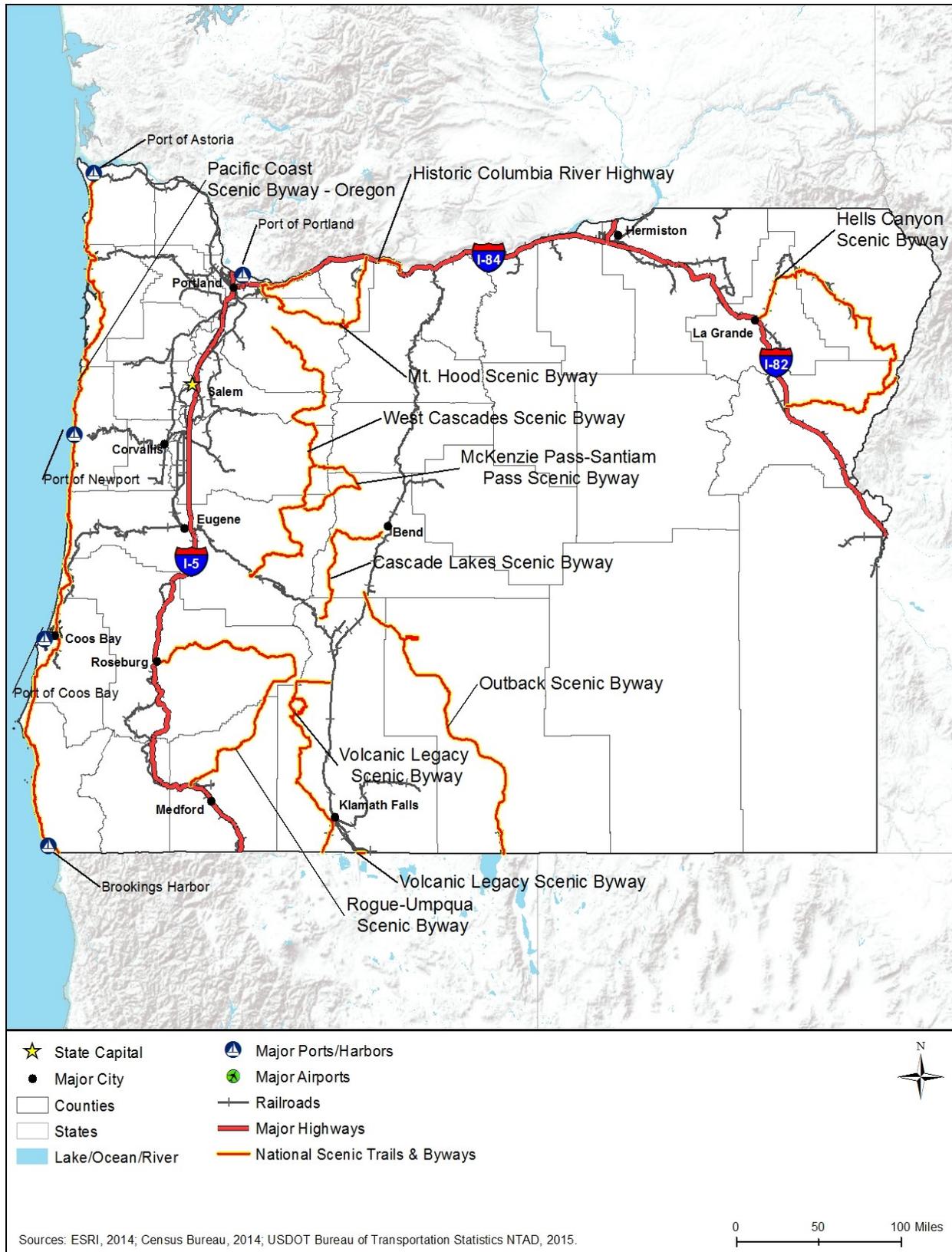


Figure 7.1.1-1: Oregon Transportation Networks

Airports

Air service to the state is provided by Portland International Airport (PDX), which is owned and operated by the City of Portland (Portland International Airport, 2015a). In fiscal year 2015, PDX served 16,126,626 passengers, facilitated approximately 216,000 aircraft operations, and moved 223,293 tons of freight (Portland International Airport, 2015b). PDX is the 30th busiest airport in the nation, in terms of the number of passengers served (FAA, 2015b). Figure 7.1.1-1 identifies the location of the airport in the state. Section 7.1.7.6, Airspace, provides detail on airports and airspace in Oregon.

Rail Networks

Oregon is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 7.1.1-1 illustrates the major transportation networks, including rail lines, in Oregon.

Amtrak runs three lines through Oregon: Cascades, Coast Starlight, and Empire Builder. Cascades makes multiple daily trips between Vancouver and Eugene with five stops in Oregon. Coast Starlight runs daily between Seattle and Los Angeles and makes six stops in Oregon. The Empire Builder runs daily between Chicago and Portland, making one stop in Oregon. Table 7.1.1-3 provides a complete list of Amtrak lines that run through Oregon.

Table 7.1.1-3: Amtrak Train Routes Serving Oregon

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Oregon
Cascades	Vancouver, BC	Eugene, OR	10 hours 25 minutes	Eugene, Albany, Salem, Oregon City, Portland
Coast Starlight	Seattle, WA	Los Angeles, LA	35 hours	Portland, Salem, Albany, Eugene, Chemult, Klamath Falls
Empire Builder	Chicago, IL	Portland, OR	46 hours	Portland

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

The Westside Express Service (WES) is a commuter railroad operated by TriMet that serves the Portland metropolitan area (ODOT, 2014) (TriMet, 2015a). The WES serves five stations on a 14.7-mile route and makes 16 roundtrips per day (ODOT, 2014). In 2013, 345,510 passengers originated their commute on the WES (ODOT, 2014). The WES connects to Portland’s MAX light rail service, which is also operated by TriMet (TriMet, 2015a). The MAX operates five lines that radiate out from downtown Portland (TriMet, 2015b). In fiscal year 2014, the MAX served 38,228,800 boarding rides (TriMet, 2015c). The MAX also connects with Portland’s three streetcar lines, forming a comprehensive commuter transit network for Oregonians (TriMet, 2015b).

Two Class I freight railroad companies operate in Oregon: BNSF Railway and Union Pacific Railroad (ODOT, 2014). Combined, these two Class I railroads own 1,111 miles of track in Oregon (ODOT, 2014). In addition, 1 Class II and 19 Class III freight rail companies run in the

state (ODOT, 2014). Combined, the Class II and III railroads own the remaining 1,258 miles of track in Oregon (ODOT, 2014).

Harbors and Ports

Oregon is bordered to the west by the Pacific Ocean. The coastline is dotted with rivers and small inlets, and is home to 29 harbors (U.S. Harbors, 2015). Some of these are used for fishing or recreational boating operations, while others support large-scale shipping facilities. The Oregon Public Ports Association oversees 23 ports in the state. These complexes “provide recreational, commercial, and economic services to residents and businesses in Oregon and beyond, serving as state, national, and international transportation gateways” and provide one out of every six jobs in the state (OPPA, 2015a). Brookings Harbor is the busiest recreational harbor on the Oregon coast. It has over 95,000 annual recreational users. (Port of Brookings Harbor, 2016). While many are located along the western coast, there are also harbors along the Columbia River, which separates the states of Oregon and Washington (OPPA, 2015b). The ports of Portland, Coos Bay, Astoria, and Newport provide overseas shipping facilities (U.S. Census Bureau, 2015c). As depicted in Figure 7.1.1-1, their locations along the northwest American coastline allow for shipping across the Pacific.

The Port of Portland, the largest port in the state, has facilities along the Columbia and Willamette Rivers, inland from the coast. The Port is easily reached via I-5, which runs across the rivers (Port of Portland, 2015a). The Port’s facilities are directly served by BNSF Railway and Union Pacific, with connections to CSX, Norfolk Southern, Canadian National Railway-Illinois Central, Canadian Pacific Rail, Kansas City Southern Railway, and FFX Mexico (Port of Portland, 2015b). With four terminals, the port can handle a variety of cargo including automobiles, steel, forest products, and machinery (Port of Portland, 2015c) (Port of Portland, 2015d). In 2013, the Port of Portland was responsible for importing \$8.3 billion worth of cargo, weighing nearly 4.06 million tons (U.S. Census Bureau, 2015d); and exporting \$4.4 billion in cargo, weighing 11.9 million tons (U.S. Census Bureau, 2015e).

The Port of Coos Bay is the second busiest port in the state, with facilities on the banks of the Coos Bay, offering a deep-draft harbor (Port of Coos Bay, 2015a) (Port of Coos Bay, 2015b). The port imports and exports include lumber, steel, industrial equipment, agricultural products, fertilizer, and cement (Port of Coos Bay, 2015c). In 2013, the port imported cargo valued at \$2.9 million, weighing 17,857 tons (U.S. Census Bureau, 2015d), while exporting cargo valued at \$170.3 million, weighing 2.0 million tons (U.S. Census Bureau, 2015e).

The Port of Astoria, located near the mouth of the Columbia River, can be reached via Oregon Highways 26 and 30, and by Washington State Highways 101 and 8. Rail lines from Portland and Western railroad provide overland transport (Port of Astoria, 2015). While some of the facilities on the harbor are dedicated to boating, fishing, and cruise ships, cargo vessels are an important part of port operations (Port of Astoria, 2015). In 2013, the Port of Astoria was able to import \$3.8 million worth of cargo, weighing 1,874 tons (U.S. Census Bureau, 2015d). They were also able to export \$50.6 million, weighing 413,808 tons (U.S. Census Bureau, 2015e).

Located on the central Oregon coast, the Port of Newport is a deep-draft port and includes forest products among its most important imports and exports (Port of Newport, 2015a). The Port of Newport’s facilities can be reached via Highway 101 (Port of Newport, 2015b). In 2013, the port brought in \$200,000 in cargo, weighing 110 tons (U.S. Census Bureau, 2015d), while exporting \$15.5 million in cargo, which weighed 10,803 tons (U.S. Census Bureau, 2015e).

7.1.1.4. Public Safety Services

Oregon public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. Table 7.1.1-4 presents Oregon’s key demographics including population (estimated); households; land area; population density; and number of counties, cities/towns, and municipal governments. More information about these demographics is presented in Section 7.1.9, Socioeconomics; however, these demographics are key to understanding the breadth of public safety services throughout the state.

Table 7.1.1-4: Key Oregon Indicators

Oregon Indicators	
Estimated Population (2014)	3,970,239
Land Area (square miles) (2010)	95,988
Population Density (persons per sq. mile) (2014)	41
Municipal Governments (2013)	242

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

Table 7.1.1-5 presents Oregon’s public safety infrastructure, including fire and police stations. Table 7.1.1-6 identifies first responder personnel including dispatch, fire and rescue, law enforcement, and emergency medical personnel in the state.

Table 7.1.1-5: Public Safety Infrastructure in Oregon by Type

Infrastructure Type	Number
Fire and Rescue Stations ^a	709
Law Enforcement Agencies ^b	174
Fire Departments ^c	307

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

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

Table 7.1.1-6: First Responder Personnel in Oregon by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers ^a	860
Fire and Rescue Personnel ^b	11,559
Law Enforcement Personnel ^c	9,431
Emergency Medical Technicians and Paramedics ^{d e}	1,900

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

^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.

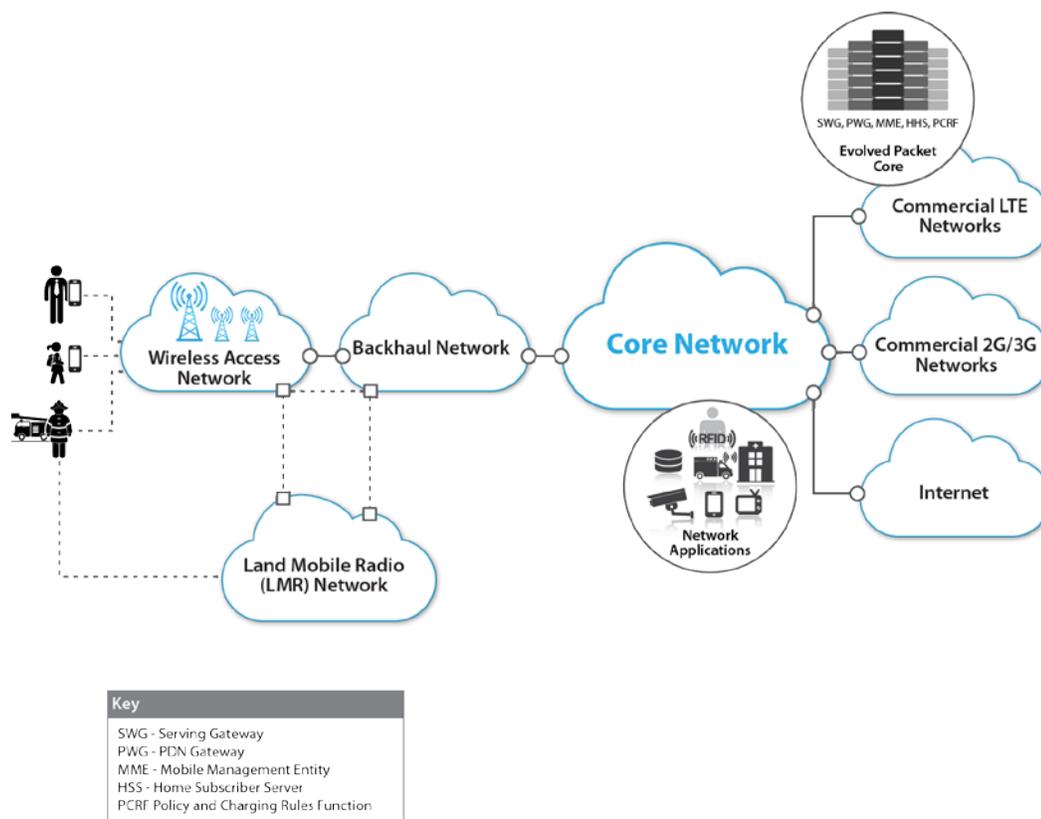
^d BLS Occupation Code: 29-2041.

^e All BLS data collected in 2015.

7.1.1.5. Telecommunications Resources

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

Communications throughout the state are based on a variety of publicly and commercially owned technologies, including coaxial cable (traditional copper cable), fiber optics, hybrid fiber optics/coaxial cable, microwave, wireless, and satellite systems providing voice, data, and video services (BLS, 2016). Figure 7.1.1-2 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 an long-term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).



Prepared by: Booz Allen Hamilton

Figure 7.1.1-2: Wireless Network Configuration

Public Safety Communications

In order to protect and best serve the public interest, first responder and law enforcement communities must be able to communicate effectively. The evolution of the communications networks used by public safety stakeholders toward a broadband wireless technology, such as LTE (see Section 2.1.1), has the potential to provide users with better coverage, while offering additional capacity and enabling the use of new applications that would 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 affecting information sharing are network coverage gaps, land mobile radio system infrastructure diversity, insufficient budgets, and diverse radio frequencies. Communication interoperability has also been a persistent challenge, along with issues concerning spectrum availability, embedded infrastructure, and differing standards among stakeholders (NTFI, 2005). This has caused a fragmented approach to communications implementation across the U.S. and at the state level, including in Oregon.

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.

In 2015, 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, prepared a locations-based services (LBS) research and development roadmap. The roadmap examines the current state of location-based technologies, forecasts the evolution of LBS capabilities and gaps, and identifies potential research and development opportunities that would improve the public safety community’s use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years (PSCR, 2015).

Like most states, Oregon’s public safety LMR network environment is facing transition. The Oregon Statewide Radio Project (SRP) has replaced Oregon’s communications predecessor, Oregon Wireless Interoperability Network (OWIN). The SRP has re-scoped and redefined the state’s approach to statewide interoperability, and now relies on its SRP system with a dual focus on: (1) microwave backbone digitization, and (2) development of a more efficient and phased deployment digital P25 state network (ODOT, 2015d).

Statewide/Multi-County Public Safety Networks

Oregon’s SRP is the current focus of the state’s LMR modernization approach aimed at delivering a more capable, integrated, and efficient state public safety network. The ODOT defines the SRP network’s four objectives as: (1) upgrade aging LMR infrastructure, (2) comply with LMR Federal Communication Commission (FCC) narrow banding requirements, (3) consolidate the ODOT and OSP LMR networks into a single more efficient system, and (4) provide limited, local interoperability while creating a basis for expanded interoperability in the future (ODOT, 2015e).

In 2005, the OWIN was established as Oregon lawmakers “called for the creation of an interoperable communications infrastructure that would allow all state, local, federal, and tribal public safety agencies to share information instantly. The [OWIN] was established and funded to manage the multi-faceted project” (ODOT, 2016). In June 2011 the Oregon Legislature authorized the SRP, and in July 2013 the integration of the ODOT and OSP LMR networks was completed thereby forming the basis for a future SRP network P25 expansion.

According to ODOT, the SRP is intended to be a phased modernization of the statewide public safety system focused initially on coverage, “that includes the Willamette Valley, north to the Columbia River Gorge, east to The Dalles and south to Bend” (ODOT, 2015f). Oregon’s SRP network is being modernized in phases and, according to the ODOT Progress Dashboard (as of September 2015), Oregon has installed digital microwave equipment on 95 of 141 total

microwave sites, completed tower site improvements on 131 of 156 sites, and installed antennas on 102 of 126 sites needing antenna upgrades (ODOT SRP Program Management, 2015).

County/City Public Safety Networks

In Oregon, county and local public safety communications have been supported by a diverse set of systems and frequencies including Very High Frequency (VHF)² and Ultra High Frequency (UHF).³ As discussed above, Oregon has standardized on the SRP, a Phase 2 digital P25 system,⁴ as the basis for its statewide LMR modernization plan, with multiple counties and cities already having migrated to the system (Project25.org, 2015a). There are six P25 systems in Oregon (Table 7.1.1-7), including Oregon’s 700MHz statewide network, SRP (Project25.org, 2015a) (Project25.org, 2015b).

Table 7.1.1-7: Oregon Public Safety P25 Networks

Oregon P25 Public Safety Systems	Frequency Band
Portland Public Safety P25 Radio System	700 MHz
SW 7 County Interoperability Public Safety Radio	UHF Lo/700 MHz
U.S. Dept. of Justice: Integrated Wireless Network (IWIN)	VHF
Oregon State Radio Project (SRP)	700 MHz
Frontier Digital Network	700 MHz
Washington County Consolidated Communications Agency	800 MHz

Sources: (Project25.org, 2015a) (Project25.org, 2015b)

The Portland Public Safety digital P25 system, operating at 700 MHz, provides communications to multiple system talk groups including the Portland Police Bureau and Radio Technicians (via encrypted channels; in addition, 800 MHz interoperability is available on one of the Portland Public Safety P25 System channels). The Portland P25 system also provides simulcast capability to Multnomah County and Goat Mountain in Clackamas County (RadioReference.com, 2015a).

The SW [Southwest] 7 County Interoperability Public Safety Radio Partnership system provides UHF LMR communications to seven counties in southwest Oregon (Lane, Benton, Josephine, Douglas, Coos, Curry, Linn, and Benton). The system supports multiple public safety county talk groups, as well as police talk groups in the cities of Eugene and Springfield (RadioReference.com, 2015b).

The OWIN system, part of the Justice Integrated Wireless Network, is a legacy P25 VHF system developed under the auspice of the U.S. Department of Justice with the intention of addressing interoperability needs across federal, state, and local public safety agencies. The Justice Integrated Wireless Network provides VHF interoperable communications across 34 counties nationwide with service in Washington, Oregon, Virginia, and the District of Columbia. In Oregon, OWIN covers Douglas, Coos, and Jackson Counties (RadioReference.com, 2015c). The Frontier Digital Network, operating at 700 MHz, provides public safety wide area communications to three counties in Oregon (Sherman, Gilliam, and Wheeler) and to one county

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

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

⁴ P25 Phase 2 systems use Time Division Multiple Access (TDMA) as the channel management regime; Oregon’s Phase 2 P25 systems are the SRP, the Frontier Digital Network, and the WCCCA.

in the state of Washington (Klickitat). In addition, this P5 system supports sheriff dispatch in Gilliam and Sherman Counties in Oregon (RadioReference.com, 2015d).

The Washington County Consolidated Communications Agency (WCCCA) system, an Oregon LMR network, is an 800 MHz P25 network providing police, fire, and EMS dispatch services to the Counties of Washington, Yamhill, and Clackamas (RadioReference.com, 2016).

Public Safety Answering Points

According to the FCC’s Master public safety answering point (PSAP) registry, there are 100 PSAPs in Oregon serving Oregon’s 36 counties (FCC, 2015a).

Commercial Telecommunications Infrastructure

Oregon’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 Oregon’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

Oregon’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 as well as cable submarine systems for international connectivity (BLS, 2016). Table 7.1.1-8 presents the number of providers of switched access⁵ lines, Internet access⁶, and mobile wireless services including coverage.

Table 7.1.1-8: Telecommunications Access Providers and Coverage in Oregon (2013)

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines ^a	152	97.6% of households ^b
Internet access ^c	86	63% of households
Mobile wireless ^d	7	91% of population

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

⁵ “A service connection between an end user and the local telephone company’s switch; the basis of plain old telephone services (POTS)” (FCC, 2014a).

⁶ Internet access includes Digital Subscriber Line (DSL), cable modem, fiber, satellite, and fixed wireless providers.

^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 7.1.1-8 by technology provided; the number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers. Household coverage is provided in Table 13 (FCC, 2014a).

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

Table 7.1.1-9 shows the wireless providers in Oregon along with their geographic coverage. The following four maps: Figure 7.1.1-3, Figure 7.1.1-4, Figure 7.1.1-5, and Figure 7.1.1-6 show the combined coverage for the top two providers; Sprint and T-Mobile's coverage; U.S. Cellular; Bend Broadband, and Yellowknife Wireless Company LLC's coverage; and the coverage of all other providers with less than 5 percent coverage area, respectively.⁷

Table 7.1.1-9: Wireless Telecommunications Coverage by Providers in Oregon

Wireless Telecommunications Providers	Coverage
Verizon Wireless	68.27%
AT&T Mobility LLC	66.36%
U.S. Cellular	34.68%
T-Mobile	14.16%
Sprint	12.33%
Bend Broadband	9.54%
Yellowknife Wireless Company, LLC	7.28%
Other ^a	18.37%

Source: (NTIA, 2014)

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

^aOther: Provider with less than 5 percent coverage area. Providers include: Freewire Broadband LLC; PEAK Internet; Snake River PCS; Webformix Company; Alyrica Networks, Inc.; OnlineNW; Cricket Wireless; UnwiredWest Internet; DC Wireless; Whiz To Coho, Inc.; FireServe; SawNet; M2 MachMedia; PrineTIME Internet Solutions; EONI.com; OneWave Networks; Community Broadband; Rural Technology Group; Ispeed Wireless; Cavenet; Upward Access; Wtechlink; PocketiNet Communications Inc.; Safelink Internet Services; EasyStreet Online; Eastern Oregon Telecom; SpeedyQuick Networks; Outreach Internet; Wallowa Valley Networks; Tnet Broadband Internet LLC; Cascade Networks, Inc.; Douglas Fast Net; Gorge Networks; Communications Access Cooperative Holding Enterprise; Applegate Broadband LLC; Cal-Ore Communications Inc.; OregonFAST.net; SandyNet; Siuslaw Broadband; Ashland Fiber Network; Stephouse Networks; Oregon Telephone Corporation; Pine Telephone Systems, Inc.; WarmSprings Telecommunications Co.; Reliance Connects; MTE Communications; Stayton Cooperative Telephone Company; Cottage Grove Wifi; EarthLink Business

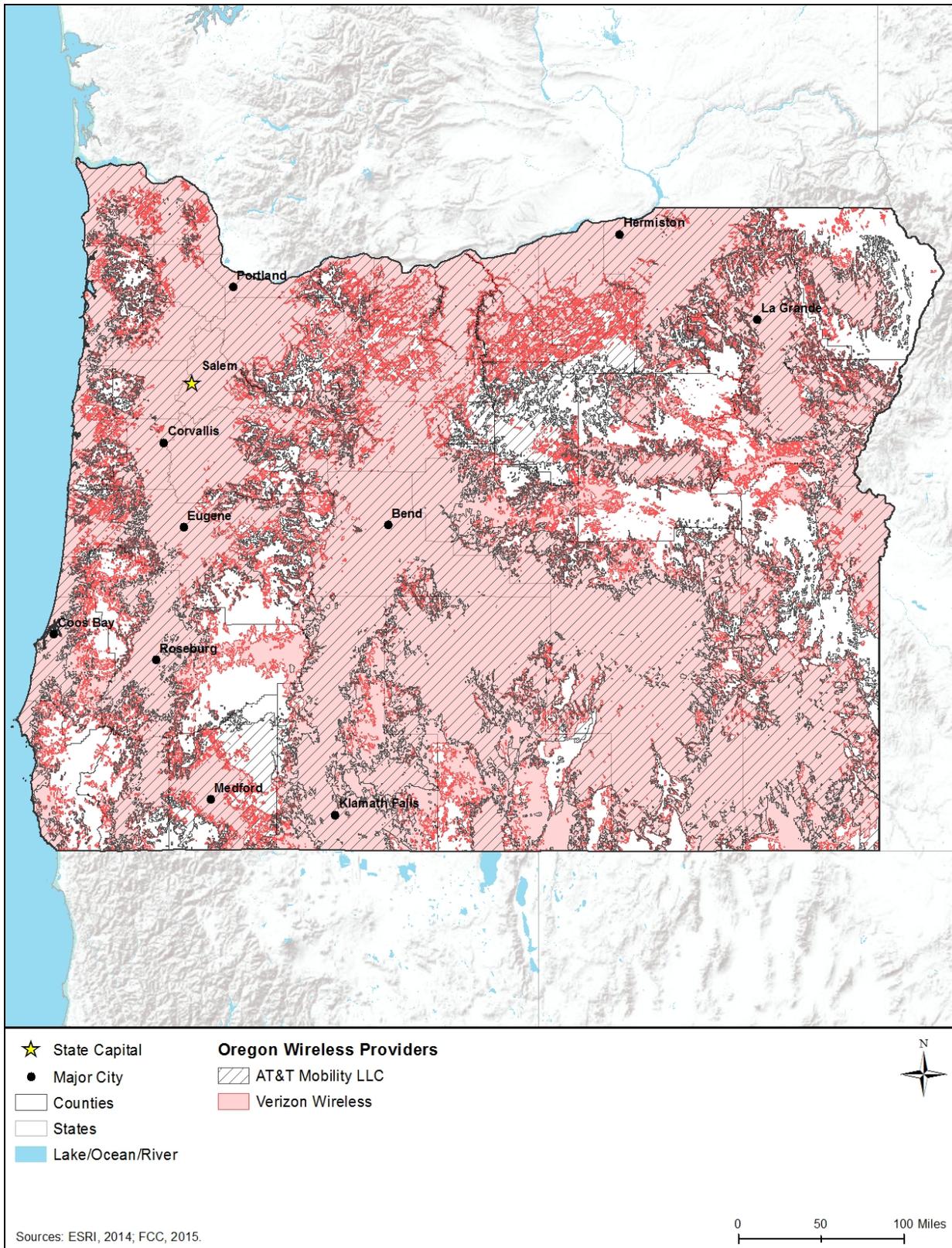


Figure 7.1.1-3: Top Wireless Providers Availability in Oregon

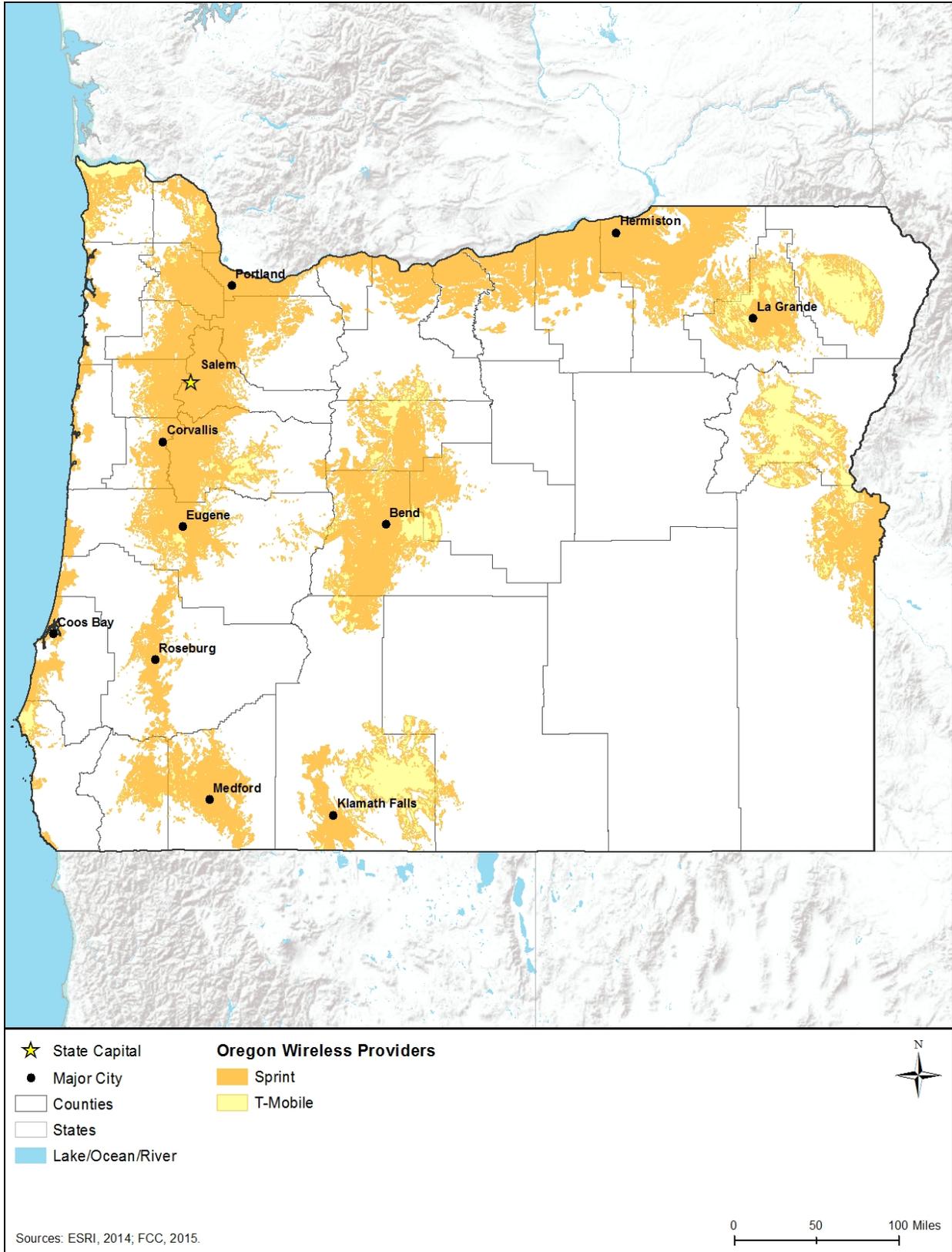


Figure 7.1.1-4: Sprint and T-Mobile Wireless Availability in Oregon

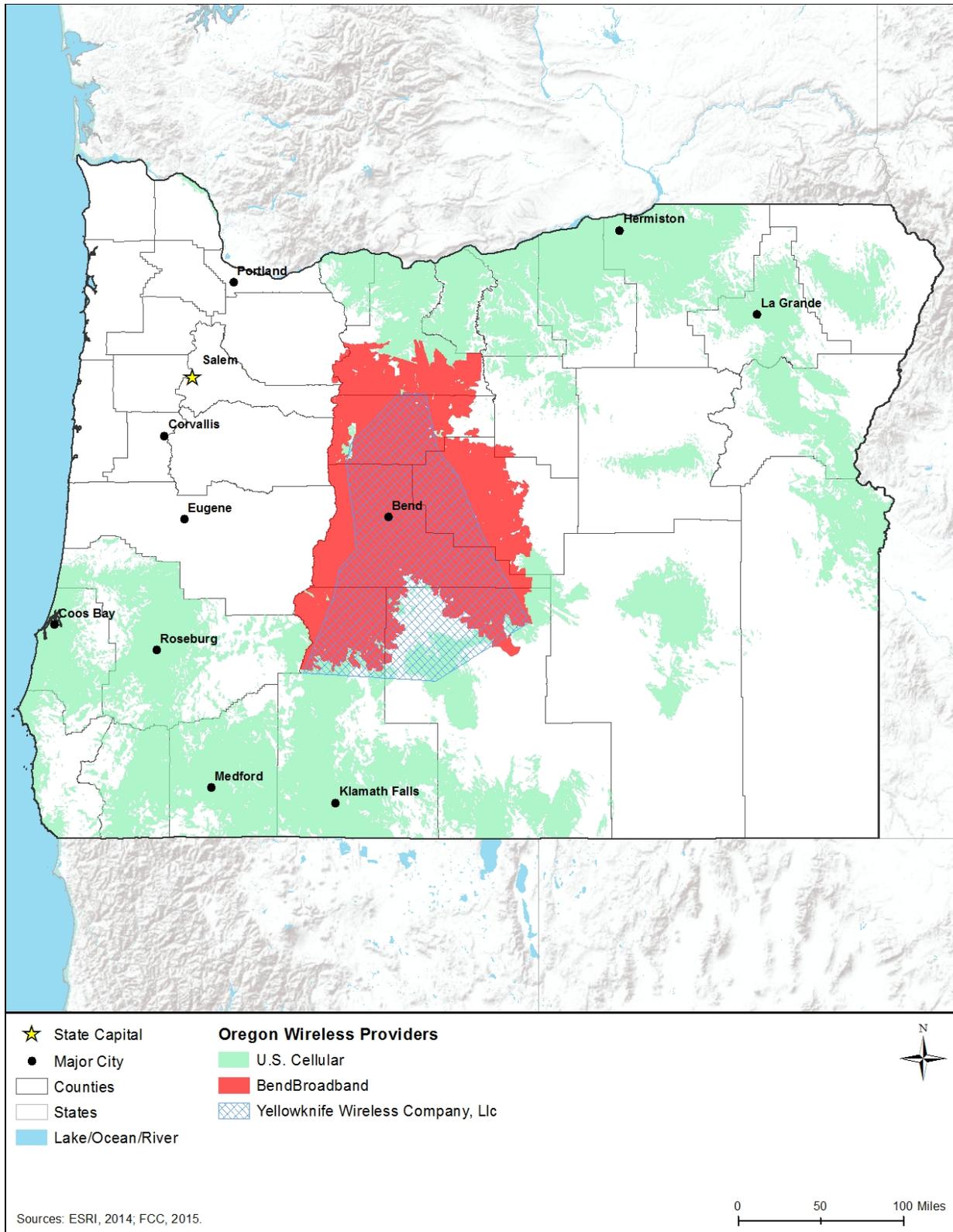


Figure 7.1.1-5: U.S. Cellular, Bend Broadband, and Yellowknife Wireless Company LLC Wireless Availability in Oregon

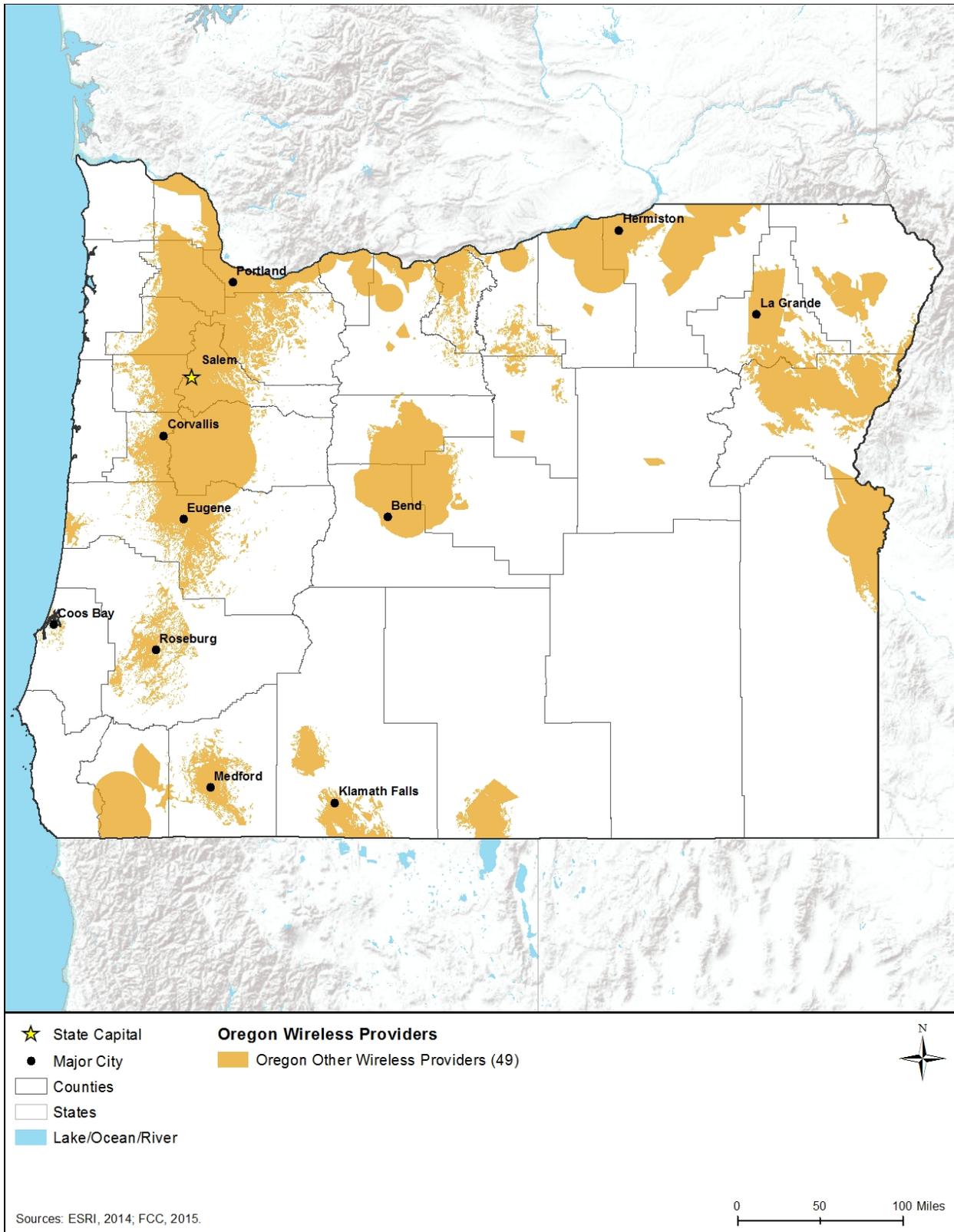


Figure 7.1.1-6: Other Providers Wireless Availability in Oregon

Towers

There are many types of domestic towers employed today by the telecommunications industry, government agencies, and other owners. Towers are designed and used for a variety of purposes, and the height, location, and supporting structures and equipment are all designed, constructed, and operated according to the technical specifications of the spectrum used, the type of equipment mounted on the tower, geographic terrain, need for line-of-sight transmissions to other towers, radio frequency needs, and other technical specifications. There are three general categories of stand-alone towers: monopole, lattice, and guyed. Typically, monopole towers are the smallest, followed by lattice towers at a moderate height, and guyed towers at taller heights (with the guyed wires providing tension support for the taller heights) (CSC, 2007). In general, taller towers can provide communications coverage over larger geographic areas, but require more land for the actual tower site, whereas shorter towers provide less geographic coverage and require less land for the tower site (USFS, 2009a). Figure 7.1.1-7 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 7.1.1-7: Types of Towers

Telecommunications tower infrastructure proliferates throughout Oregon, although tower infrastructure is concentrated in the higher and more densely populated areas of Oregon. Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b)⁸. Table 7.1.1-10 shows the number of towers (including broadcast towers)

⁸ An antenna structure must be registered with the FCC if the antenna structure is taller than 200 feet aboveground level or may interfere with the flight path of a nearby airport. (FCC, 2016b)

registered with the FCC in Oregon, by tower types, and Figure 7.1.1-8 presents the location of those structures, as of June 2016.

Table 7.1.1-10: Number of Commercial Towers in Oregon by Type

Constructed^a Towers^b		Constructed Monopole Towers	
100ft and over	15	100ft and over	0
75ft – 100ft	60	75ft – 100ft	0
50ft – 75ft	143	50ft – 75ft	10
25ft – 50ft	308	25ft – 50ft	95
25ft and below	124	25ft and below	21
Subtotal	650	Subtotal	126
Constructed Guyed Towers		Buildings with Constructed Towers	
100ft and over	1	100ft and over	0
75ft – 100ft	4	75ft – 100ft	0
50ft – 75ft	2	50ft – 75ft	1
25ft – 50ft	11	25ft – 50ft	3
25ft and below	1	25ft and below	3
Subtotal	19	Subtotal	7
Constructed Lattice Towers		Multiple Constructed Structures^c	
100ft and over	1	100ft and over	0
75ft – 100ft	8	75ft – 100ft	0
50ft – 75ft	37	50ft – 75ft	0
25ft – 50ft	24	25ft – 50ft	0
25ft and below	20	25ft and below	0
Subtotal	90	Subtotal	0
Constructed Tanks^d			
Tanks	4		
Subtotal	4		
Total All Tower Structures		896	

Source: (FCC, 2015b)

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

^b Self-standing or guyed (anchored) structure used for communication purposes (FCC, 2012)

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

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

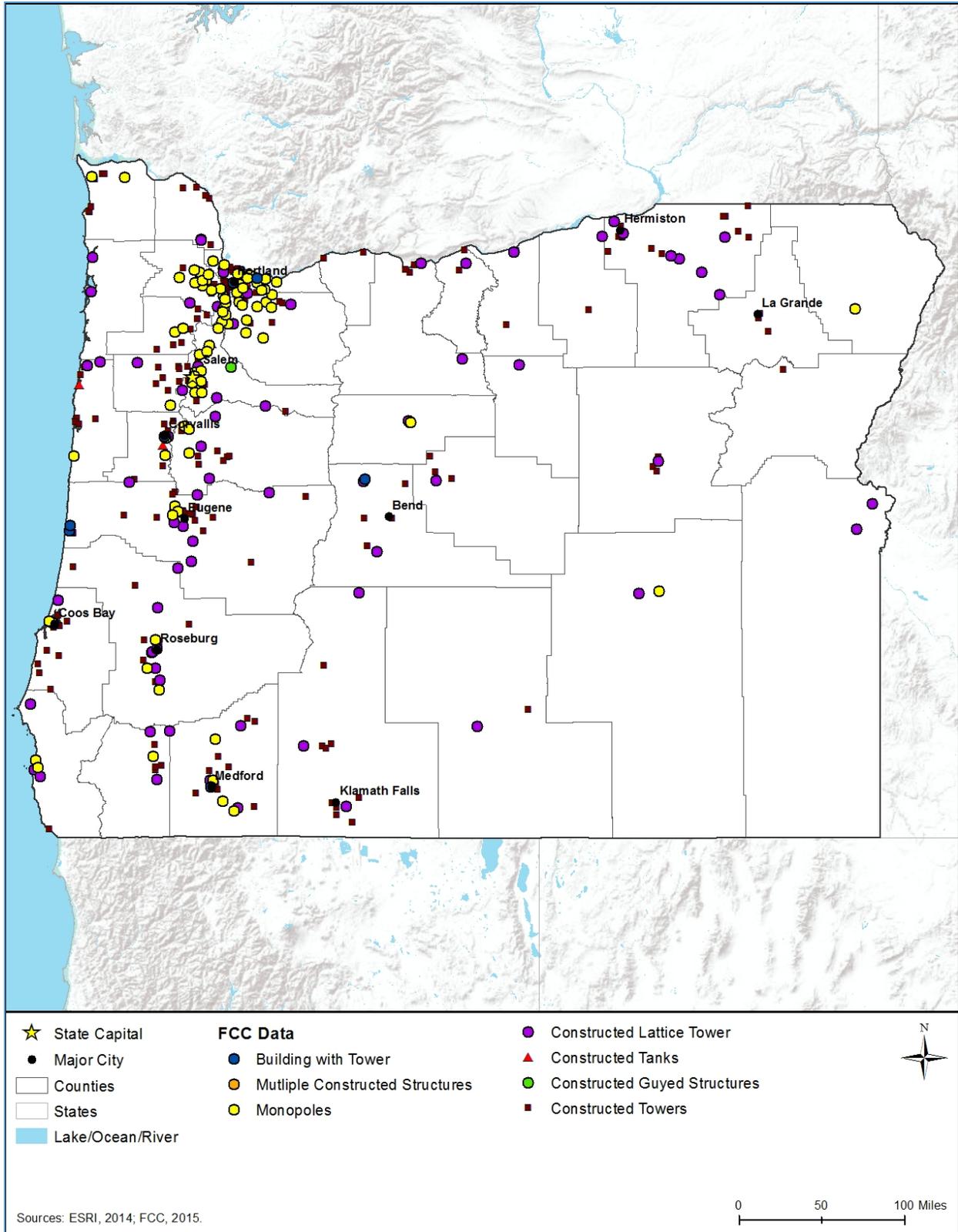


Figure 7.1.1-8: FCC Tower Structure Locations in Oregon

Fiber Optic Plant (Cables)

Fiber optic plant, or cables, can be buried directly in the ground; pulled, blown, or floated into ducts, conduits, or innerduct (flexible plastic protective sleeves or tubes); placed under water; or installed aerially between poles, typically on utility rights-of-way (ROWs). A fiber optic network includes an access network consisting of a central office, distribution and feeder plant (cables of various sizes directly leaving a central office and splitting to connect users to the network), and a user location, as shown in Figure 7.1.1-9. 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).

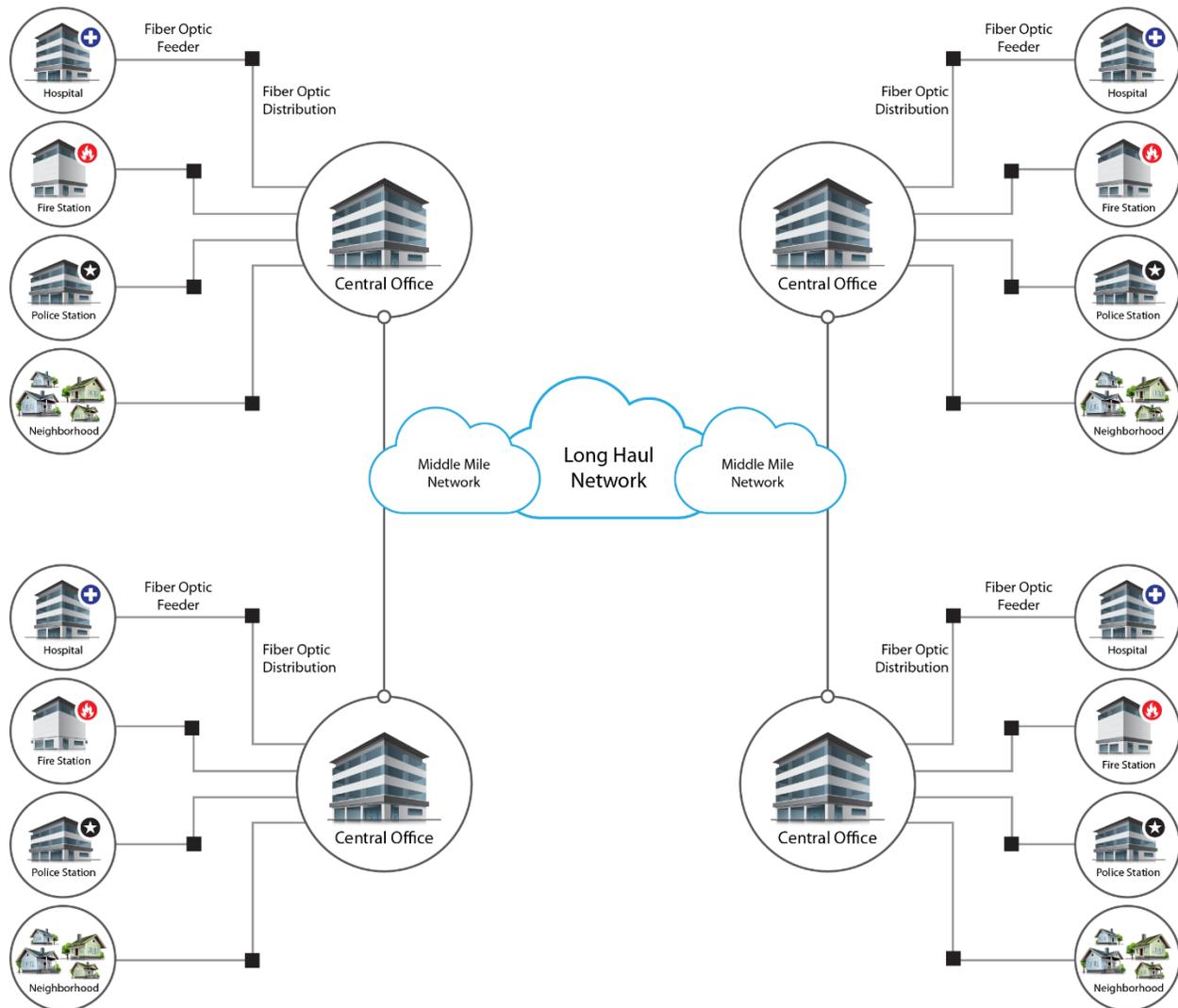


Figure 7.1.1-9: Typical Fiber Optic Network in Oregon

Source: (ITU-T, 2012)

Prepared by: Booz Allen Hamilton

Last Mile Fiber Assets

In Oregon, fiber access networks are concentrated in the highest population centers as shown in the figures below. Table 7.1.1-11 lists the 71 fiber providers that offer service in the state. Figure 7.1.1-10 shows coverage for CenturyLink, Integra Telecom, Charter Communications Inc., and Frontier Communications, while Figure 7.1.1-11 shows coverage for all other providers with less than 5 percent coverage area, respectively.

Table 7.1.1-11: Fiber Provider Coverage in Oregon

Fiber Provider	Coverage
CenturyLink	4.92%
Integra Telecom	3.00%
Charter Communications Inc.	2.68%
Frontier Communications	2.09%
Other ^a	8.00%

Source: (NTIA, 2014)

^aOther: Provider with less than 5 percent coverage area. Providers include: Cogent Communications Group; City of Cascade-Locks; J & N Cable Systems, Inc.; Fibersphere; Blue Mountain Cable; Cal-Ore Communications Inc.; SCS Communications; SandyNet; QualityLife Intergovernmental Agency; Elgin TV Association, Inc.; MINet; TW Telecom Of Oregon LLC; Ashland Fiber Network; Pendleton Fiber Company; XO Communications Services, Inc. (Affiliated Entity); ORCA Communications; Comspan Communications, Inc.; TDS TELECOM; Level 3 Communications, LLC; Cable ONE; Coltontel; Mount Angel Telephone Company; OnlineNW; Datavision Communications; Axis Communications; Country Vision Cable Inc.; Monitor Cooperative Telephone Company; St Paul Telephone; Cascade Networks, Inc.; Monroe Telephone; People’s Telephone Company; Eastern Oregon Telecom; Gervais Telephone Company; Clear Creek Mutual Telephone Company; Helixtel.com; Rome Telecommunications Inc.; Eagle Telephone System, Inc.; Beaver Creek Telephone Company; FTX Networks; SCIO Mutual Telephone; Stayton Cooperative Telephone Company; Zayo Group LLC; Canby Telecom; Hunter Communications, Inc.; SawNet; InfoStructure; Molalla Communications Company; Nehalem Telecommunications Inc.; Oregon-Idaho Utilities, Inc.; Crestview Cable Communications; CoastCom, Inc.; North-State Telephone Co.; Quantum Communications; Bend Broadband; Reliance Connects; Pine Telephone Systems, Inc.; Pioneer Telephone Cooperative; MegaPath Corporation; Silver Star Telecom; Douglas Fast Net; Wave Broadband; Oregon Telephone Corporation; EarthLink Business; EONI.com; LS Networks; Comcast

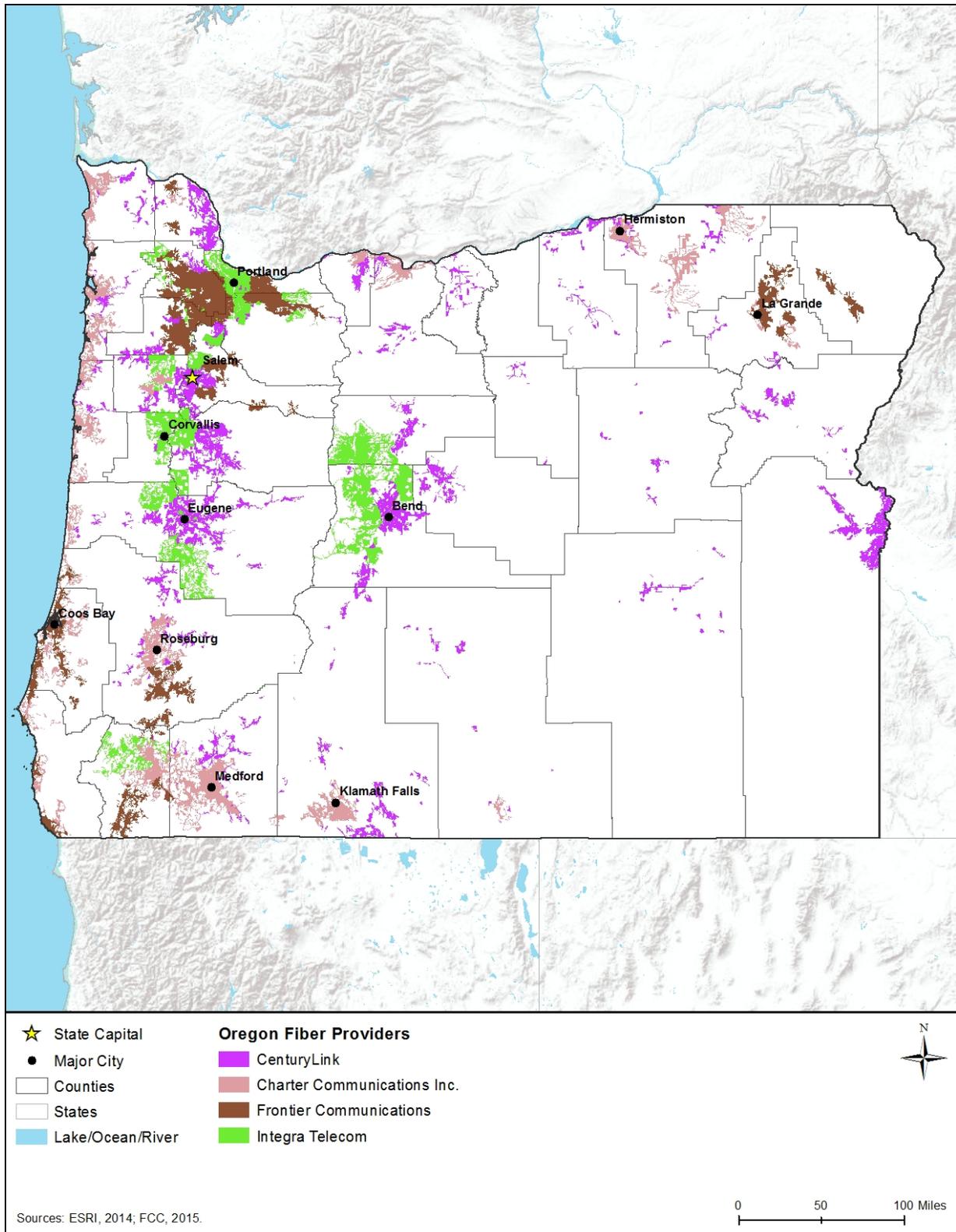


Figure 7.1.1-10: Fiber Availability in Oregon for CenturyLink, Charter Communications Inc., Frontier Communications, and Integra Telecom

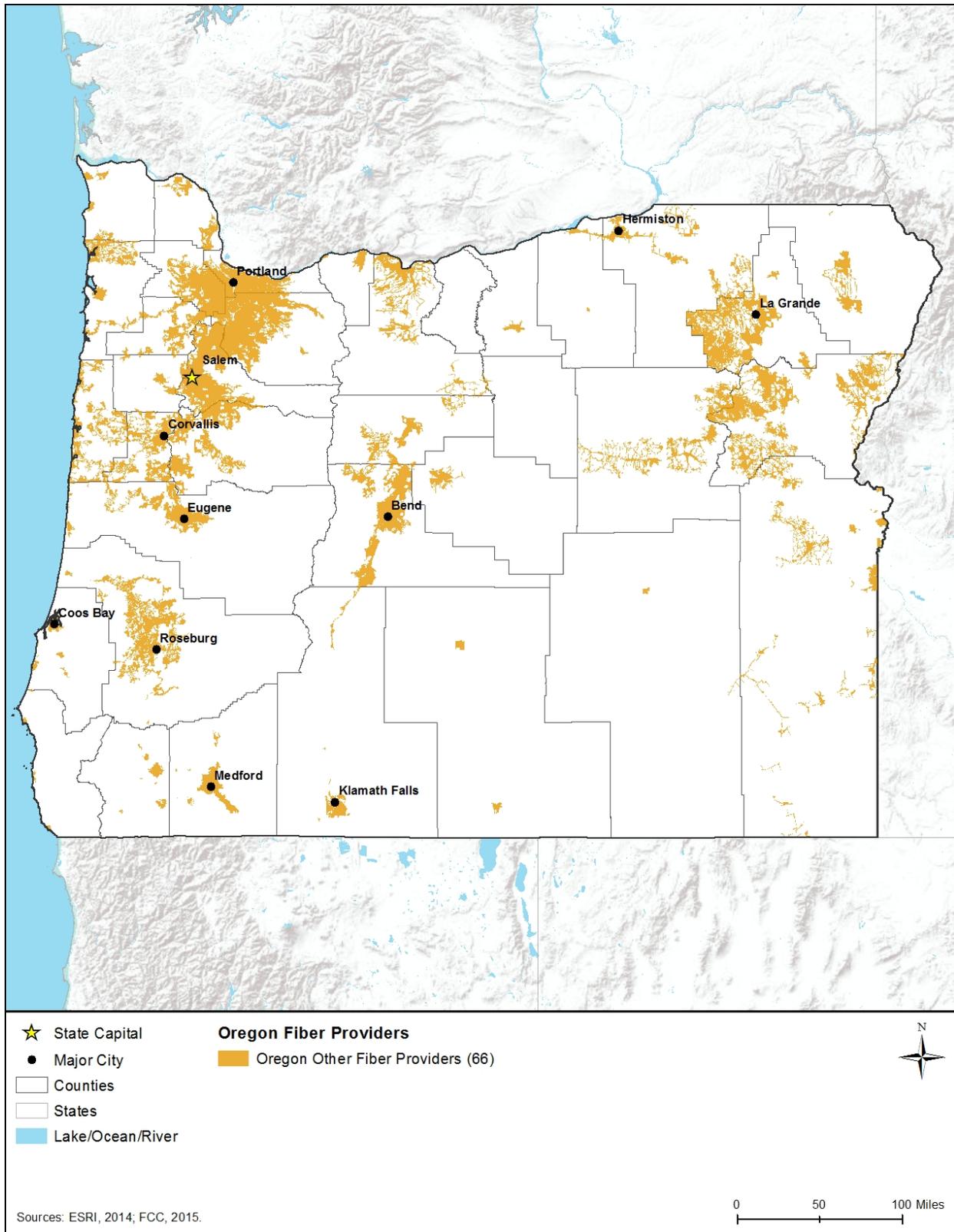


Figure 7.1.1-11: Other Providers Fiber Availability in Oregon

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. They 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, 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.

7.1.1.6. 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 7.1.4, Water Resources, describes the potable water sources in the state.

Electricity

The Oregon Public Utility Commission (PUC) regulates investor-owned electric utilities within the state. The PUC's oversight includes the regulation of the rates charged to customers and the quality of service provided. The commission does not regulate municipal utilities, electric cooperatives or utility districts, thereby only regulating the three investor owned electric utilities in the state: Idaho Power, Pacific Power and Light, and Portland General Electric (PUC, 2015a) (PUC, 2015b). The majority of the electricity produced in Oregon comes from conventional hydroelectric plants (EIA, 2015a). In 2014, 60,120,000 megawatt hours⁹ of electricity were produced. Of this, 35,262,000 megawatt hours came from hydroelectric facilities, amounting to 59 percent of the total. Natural gas and wind power also contributed significant amounts of electricity, with natural gas providing 12,699,000 megawatt hours (21 percent) and wind facilities provided 7,555,000 megawatt hours (13 percent). Other sources of electricity generation included coal and biomass contributed minute amounts as well (EIA, 2015a). Major transmission lines linking Oregon's electrical grid with nearby California and Washington accomplish interstate transfers of electricity. Oregon is also home to the only natural gas production field in the Pacific Northwest. Regarding the consumption of Oregon's electricity, nearly one-third (30.3 percent) was used by the transportation sector in 2013, 26 percent by the residential sector, 24.4 percent by the industrial sector, and 19.2 percent by the commercial sector (EIA, 2015b).

Water

Investor or privately owned water utilities also have regulatory oversight provided by the PUC. The PUC's responsibilities include the regulation of "the rates and fees charged by certain public water utilities to ensure fair and reasonable rates" (PUC, 2015e). There are 35 utilities that have

⁹ One megawatt-hour is defined as "one thousand kilowatt-hours or one million watt-hours." One watt-hour is "the electrical energy unit of measure equal to one watt of power supplied to, or taken from, an electric circuit steadily for one hour." (EIA, 2016)

their rates regulated by the commission, as well as 42 utilities whose service is subject to the PUC's oversight (PUC, 2015c) (PUC, 2015f). The Oregon Health Authority (OHA) monitors the quality of Oregon's drinking water. The state's Drinking Water Services (DWS) "administers and enforces drinking water quality standards for public water systems in the state of Oregon" (OHA, 2015a). For these purposes, public water systems are defined as systems "for the provision to the public of piped water for human consumption, if such system has more than three service connections, or supplies water to a public or commercial establishment that operates a total of at least 60 days per year, and that is used by 10 or more individuals per day. Public water system also means a system for the provision to the public of water through constructed conveyances other than pipes to at least 15 service connections or regularly serves at least 25 individuals daily at least 60 days of the year" (OHA, 2015b). The state has 2,600 public drinking water systems. About 70 percent of the population of Oregon is serviced by the 54 largest municipal water systems, though they make up but a fraction of the total systems in the state, as about 90 percent of Oregon's public water systems are small and serve less than 500 people. The 2014 U.S. Environmental Protection Agency (USEPA) Annual Compliance Report for Oregon noted 200 water systems had violations of their established Maximum Contaminant Levels. Of these, 151 violations were for excessive levels of coliform bacteria (OHA, 2015c). Community water systems (those that have "15 or more service connections used by year-round residents, or that regularly serves 25 or more year-round residents") are required to submit annual reports to their consumers including information on their water (OHA, 2015b) (OHA, 2015d). These reports, known as Consumer Confidence Reports (CCR), detail information on contaminants and the sources of a consumer's drinking water (OHA, 2015d).

Wastewater

The National Pollutant Discharge Elimination System (NPDES) permit program was originally operated by the USEPA, but operating authority was given to the Oregon Department of Environmental Quality (DEQ) in 1973. These permits, issued to wastewater generators and treatment facilities, detail the types and amounts of allowable pollutants to be discharged. Compliance monitoring and inspections occur on a regular basis, and may include sampling of wastewater to check for contaminants (Oregon DEQ, 2010). The state offers both general and individual permits. General permits are used to authorize several facilities or discharges that share characteristics such as the pollutant to be discharged or its source. This category would include "vehicle and equipment wash water" permits or "seafood processing" permits. Individual permits are used for more specific or unique operations, such as "non-ferrous metals utilizing sand chlorination" permit in the Primary Smelting or Refining Permit Category (Oregon DEQ, 2015a).

The state also requires that "owners of wastewater systems and drinking water systems (public and private) to have their systems under responsible control and direction of certified operators." As such, the Oregon DEQ offers a certification program for wastewater operators (Oregon DEQ, 2015b). The four grades of wastewater certification require differing amounts of training, education, and wastewater operation experience based on the size and scope of each grade (Oregon DEQ, 2015c).

Solid Waste Management

The Oregon DEQ manages Oregon's solid waste through permitting and monitoring of its 338 disposal sites (Oregon DEQ, 2013a). These permitted facilities range from landfills and composting facilities to incinerators and energy recovery facilities (Oregon DEQ, 2015d). As of the 2012 report, there were 55 open landfills, 142 transfer stations or material recovery facilities, and 55 compost permit or registration facilities in the state. In the last twenty years, the state has closed more than 90 landfills, though the threat of leakage continues to make monitoring necessary.

The state of Oregon generated 4.7 million tons of waste and disposed of 5.3 million tons of material in 2011, with about 36 percent of this coming from out of state. Oregon sends very little of its waste to be disposed of outside its borders (Oregon DEQ, 2013a). In 2011, there was a slight increase in per capita solid waste generation; to about 2,458 lbs./person/year, which was a 0.6 percent increase from the previous year (Oregon DEQ, 2013a). However, municipal waste disposal dropped to 1,264 lbs./person/year, which was the lowest rate in twenty years. "In 2011, the state met its recovery rate goal with a rate of 52.3 percent, an increase over the 2010 rate of 50.0 percent. The recovery rate includes materials recycled by households and businesses or sent offsite for composting and some materials burned for energy recovery." State goals include avoiding increases in both per capital municipal solid waste generation and total municipal solid waste generation (Oregon DEQ, 2013a).

7.1.2. Soils

7.1.2.1. 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, 2015c)
- (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, 2015c)

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 do.
- *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.

7.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Section 1.8, Overview of Relevant Federal Laws and Executive Orders. A list of applicable state laws and regulations is included in Table 7.1.2-1 below.

Table 7.1.2-1: Relevant Oregon Soil Laws and Regulations

State Law/Regulation	Agency	Applicability
National Pollutant Discharge Elimination System (NPDES) Permit 1200-C Construction Erosion and Sediment Control	Oregon Department of Environmental Quality (ODEQ)	Erosion and sediment control measures are required in Schedule A of the Oregon NPDES Permit 1200-C.

Source: (Oregon DEQ, 2013b)

7.1.2.3. Environmental Setting

Oregon is composed of four Land Resource Region (LRR),¹⁰ as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Northwestern Forest, Forage, and Specialty Crop Region
- Northwestern Wheat and Range Region
- Rocky Mountain Range and Forest Region
- Western Range and Irrigated Region

Within and among Oregon’s four LRRs are 17 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 Oregon’s MLRAs are presented in Figure 7.1.2-1 and Table 7.1.2-2.

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).

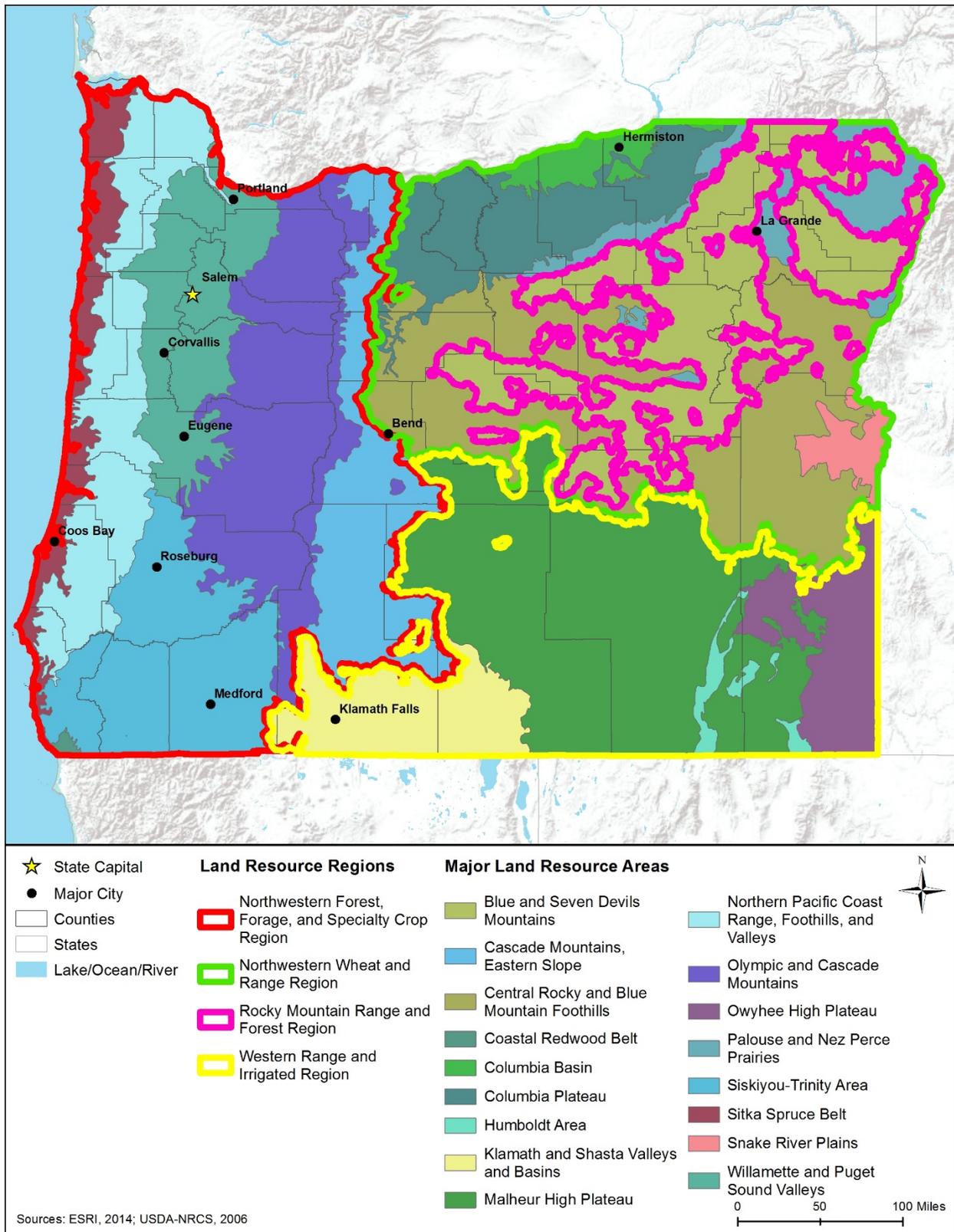


Figure 7.1.2-1: Locations of Major Land Resource Areas in Oregon

Table 7.1.2-2: Characteristics of Major Land Resource Areas in Oregon

MLRA Name	Region of State	Soil Characteristics
Blue and Seven Devils Mountains	Northeastern Oregon	Andisols ^a and Mollisols ^b are the dominant soil orders. These soils of varying texture range from very poorly drained to well drained, and range from shallow to very deep.
Cascade Mountains, Eastern Slope	Central Oregon	Alfisols ^c , Andisols, Inceptisols, ^d and Mollisols are the dominant soil orders. These well-drained soils are ashy or loamy, ^e and are moderately deep to very deep.
Central Rocky and Blue Mountain Foothills	Northeastern Oregon	Mollisols is the dominant soil order, with Aridisols ^f less so. These well-drained soils are loamy or clayey, and range from very shallow to very deep.
Coastal Redwood Belt	Southwestern Oregon	Alfisols, Entisols, ^g Inceptisols, and Ultisols ^h are the dominant soil orders. These well-drained soils are clayey or loamy, and are deep to very deep.
Columbia Basin	Northern Oregon	Aridisols and Entisols are the dominant soil orders. These well drained to excessively drained soils are moderately deep to very deep, and are loamy.
Columbia Plateau	Northern Oregon	Mollisols is the dominant soil order. These loamy and well-drained soils are typically moderately deep to very deep.
Humboldt Area	Southeastern Oregon	Aridisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These very deep soils are typically loamy and well drained.
Klamath and Shasta Valleys and Basins	Southern Oregon	Mollisols is the dominant soil order, with Histosols ⁱ and Inceptisols less so. These loamy, sandy or clayey soils range from very poorly drained to well drained, and range from shallow to very deep.
Malheur High Plateau	Southern Oregon	Aridisols and Mollisols are the dominant soil orders. These very deep soils typically range from poorly drained to well drained, and are loamy or clayey.
Northern Pacific Coast Range, Foothills, and Valleys	Western Oregon	Andisols, Inceptisols, and Ultisols are the dominant soil orders. These well-drained soils are clayey or loamy, and range from shallow to very deep.
Olympic and Cascade Mountains	Western Oregon	Andisols, Inceptisols, Spodosols, ^j and Ultisols are the dominant soil orders. These well-drained soils are typically moderately deep to very deep, and are clayey or loamy and ashy.
Owyhee High Plateau	Southeastern Oregon	Aridisols and Mollisols are the dominant soil orders. These well-drained soils range from shallow to moderately deep, and are loamy or clayey.
Palouse and Nez Perce Prairies	Northeastern Oregon	Mollisols is the dominant soil order. These loamy soils are moderately well drained to well drained, and are typically deep or very deep.
Siskiyou-Trinity Area	Southwestern Oregon	Alfisols, Inceptisols, and Ultisols are the dominant soil orders. These loamy and well-drained soils are typically moderately deep to very deep.
Sitka Spruce Belt	Western Oregon	Andisols, Entisols, Inceptisols, and Spodosols are the dominant soil orders. These soils range from poorly drained to well drained, and range from shallow to very deep.
Snake River Plains	Eastern Oregon	Aridisols is the dominant soil order. These typically well-drained soils are loamy, silty, or clayey, and range from shallow to very deep.
Willamette and Puget Sound Valleys	Western Oregon	Alfisols, Inceptisols, Mollisols, and Ultisols, are the dominant soil orders. These soils range from poorly drained to well drained, are moderately deep to deep, and are clayey or loamy.

^a Andisols: “Highly productive soils. They are common in cool areas with moderate to high precipitation, especially those areas associated with volcanic materials.” (NRCS, 2015d)

^b Mollisols: “Soils that have a dark colored surface horizon relatively high in content of organic matter. They are base rich throughout and quite fertile. Mollisols form under grass in climates that have a moderate to pronounced seasonal moisture deficit.” (NRCS, 2015d)

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

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

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

^f 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, 2015d)

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

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

ⁱ Histosols: “Histosols have a high content of organic matter and no permafrost. Most are saturated year round, but a few are freely drained. They form in decomposed plant remains that accumulate in water, forest litter, or moss faster than they decay. Histosols make up about 1 percent of the world’s ice-free land surface.” (NRCS, 2015d)

^j Spodosols: “Spodosols formed from weathering processes that strip organic matter combined with aluminum from the surface layer and deposit them in the subsoil. They commonly occur in areas of course-textured deposits under coniferous forests of humid regions, tend to be acid and infertile, and make up about 4 percent of the world’s ice-free land surface.” (NRCS, 2015d)

Soil characteristics are an important consideration for FirstNet inasmuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota¹² such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils¹³ 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 rutting¹⁴ (discussed further in the subsections below).

¹² Biota: The flora and fauna of a region.

¹³ Expansive soils are characterized by “the presence of swelling clay minerals” that absorb water molecules when wet and expand in size or shrink when dry leaving “voids in the soil” (Rogers, Olshansky, & Rogers, 2004).

¹⁴ Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength. (USFS, 2009b)

7.1.2.4. 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 taxonomy¹⁵; there are twelve soil orders in the world and they are characterized by both observed and inferred¹⁶ properties, such as texture, color, temperature, and moisture regime. Soil suborders are the next level down, and are differentiated within an order by soil moisture and temperature regimes, as well as dominant physical and chemical properties (NRCS, 2015e). The STATSGO2¹⁷ soil database identifies 31 different soil suborders in Oregon (NRCS, 2015a). Figure 7.1.2-2 depicts the distribution of the soil suborders, and Table 7.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

¹⁵ Taxonomy: “A formal representation of relationships between items in a hierarchical structure.” (USEPA, 2015s)

¹⁶ “Soil properties inferred from the combined data of soil science and other disciplines (e.g., soil temperature and moisture regimes inferred from soil science and meteorology).” (NRCS, 2015d)

¹⁷ STATSGO2 is the Digital General Soil Map of the United States developed by the National Cooperative Soil Survey and supersedes the State Soil Geographic (STATSGO) dataset; the U.S. General Soil Map is composed of general soil association units and is maintained and distributed as a spatial and tabular dataset.

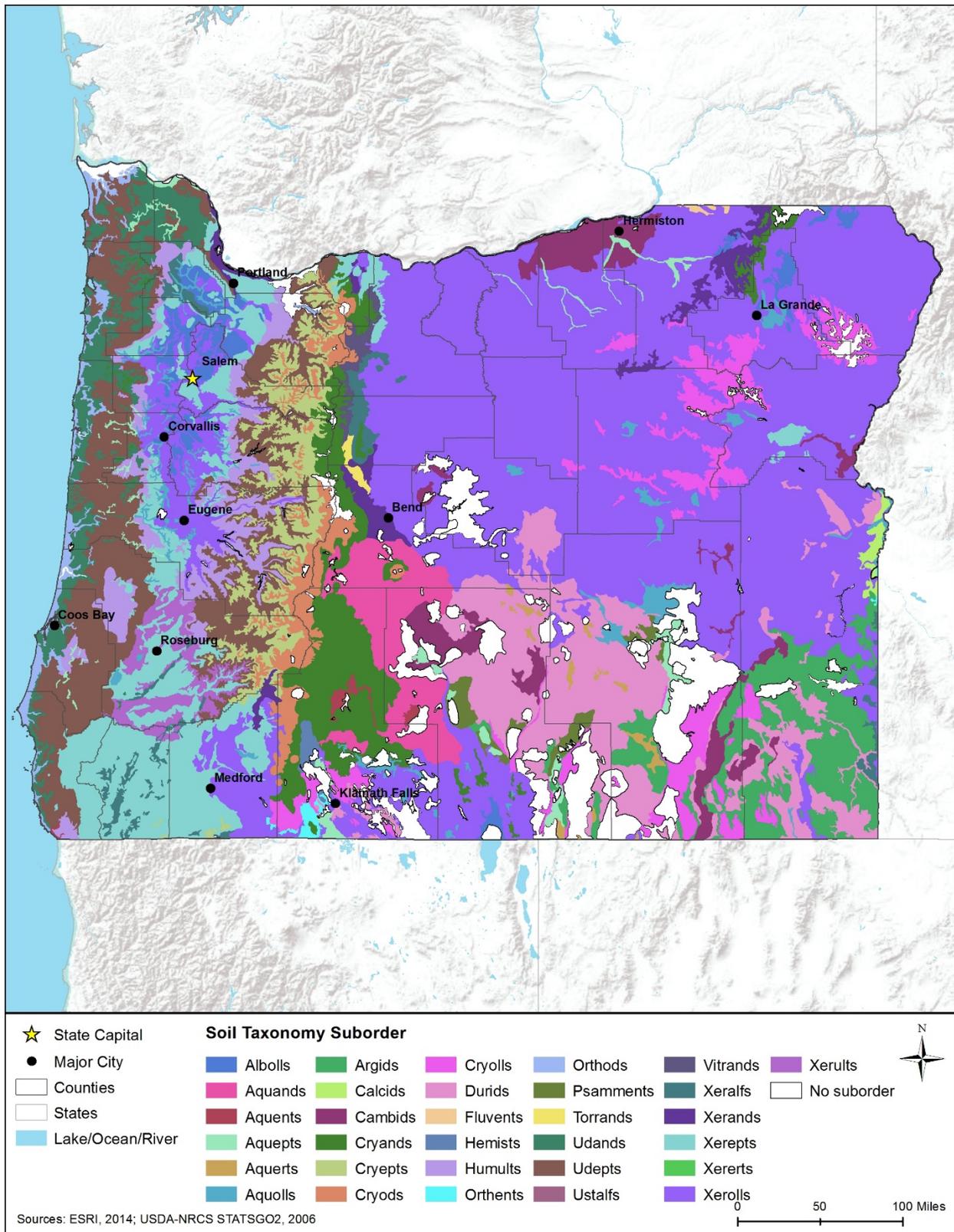


Figure 7.1.2-2: Oregon Soil Taxonomy Suborders

Table 7.1.2-3: Major Characteristics of Soil Suborders^a Found in Oregon, as depicted in Figure 7.1.2-2

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Mollisols	Albolls	Albolls have a fluctuating groundwater table, with gentle slopes. They supported grasses and shrubs, and are typically used as cropland.	Sandy clay loam, Silt loam, Silty clay loam	0-8	Poorly drained to moderately well drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Andisols	Aquands	Aquands are primarily found under grass or forest vegetation, and are used as pasture or cropland.	Loamy coarse sand	0-3	Moderately well drained	No	B	Medium	Moderate	Medium	Low
Entisols	Aquepts	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquepts support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Silt, Silty clay loam	0-3	Poorly drained to somewhat poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, groundwater is at or near the soil surface at some time during normal years (although not usually in all seasons). They are used primarily for pasture, cropland, forest, or wildlife habitat. Many Aquepts have formed under forest vegetation, but they can have almost any kind of vegetation.	Muck, Sand and gravel, Silt loam, Silty clay loam, Stratified silt loam to silty clay loam	0-3	Very poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Vertisols	Aquepts	Aquepts are wet soils, with prolonged moisture at or near the soil surface. Their natural vegetation includes savanna, grass, and forest. They are used as forest, rangeland, and cropland, although drainage for cropland can be difficult due to poor drainage.	Clay, Silty clay	0-2	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Mollisols	Aquolls	Aquolls support grass, sedge, and forb vegetation, as well as some forest vegetation. However, most have been artificially drained and utilized as cropland.	Clay, Clay loam, Fine sandy loam, Silt loam, Silty clay loam	0-3	Poorly drained to somewhat poorly drained	No, Yes	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
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.	Extremely gravelly loam, Gravelly clay, Sandy clay loam, Silt loam, Silty clay loam, Unweathered bedrock, Very stony 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.	Silt loam	0-1	Well drained	No	B	Medium	Moderate	Medium	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.	Ashy silt loam, Loamy fine sand, Sandy loam, Silt loam, Unweathered bedrock	0-80	Well drained to somewhat excessively drained	No	B, C	Medium	Moderate, Low	Medium	Low
Andisols	Cryands	Cryands are typically used as forest, and are primarily formed under vegetation in coniferous forests.	Cobbly loam, Gravelly coarse sand, Gravelly loam, Gravelly sandy loam, Loam, Sandy loam, Very gravelly coarse sandy loam, Weathered bedrock	0-80	Moderately well drained to somewhat excessively drained	No	A, B, D	Low, Medium, High	High, Moderate, Very Low	Low to High, depending on slope	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Inceptisols	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.	Very cobbly sandy loam, Very gravelly loam	35-75	Moderately well drained to well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Spodosols	Cryods	Cryods are soils of high latitudes and/or high elevations, with coniferous forest vegetation, and are used as forest or wildlife habitat.	Stony loam	3-30	Well drained	No	C	Medium	Low	Medium	Low
Mollisols	Cryolls	Cryolls are generally freely drained, cold weather soils. They are primarily used as rangeland, along with some forest and pasture. Forest, grass, or grass/shrub vegetation are supported with these soils.	Loam, Very cobbly loam, Very gravelly loam	3-75	Well drained	No	B, C	Medium	Moderate, 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).	Cemented material, Gravelly silt loam, Indurated, Sandy loam, Silt loam, Silty clay loam, Stratified gravelly sand to loam, Very stony loam	0-20	Somewhat poorly drained to well drained	No	C, D	Medium, High	Low, Very Low	Medium to High, depending on slope	Low
Entisols	Fluvents	Fluvents are mostly freely drained soils that form in recently deposited sediments on flood plains, fans, and deltas located along rivers and small streams. Unless protected by dams or levees, these soils frequently flood. Fluvents are normally utilized as rangeland, forest, pasture, or wildlife habitat, with some also used for cropland.	Gravelly fine sandy loam	0-3	Somewhat excessively drained	No	B	Medium	Moderate	Medium	Low
Histosols	Hemists	Hemists are usually found in broad, flat areas, such as coastal plains and outwash plains as well as closed depressions. They are typically under natural vegetation and uses for rangeland, woodlands, and/or wildlife habitat, although some large areas have been cleared and drained, and utilized for cropland.	Muck	0-1	Very poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Ultisols	Humults	Humults are generally freely drained and support both coniferous forest and rain forest. They are primarily used as pasture, forest, or cropland.	Silt loam, Silty clay loam, Weathered bedrock	2-60	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Fine sandy loam, Sandy loam	0-70	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Spodosols	Orthods	Orthods have a moderate accumulation of organic carbon, and are relatively freely drained. Most of these soils are either used as forest or have been cleared and are used as cropland or pasture. Although they are naturally infertile, they can be highly responsive to good management.	Extremely cobbly coarse sand, Sandy loam	0-50	Poorly drained to well drained	No, Yes	B, D	Medium, High	Moderate, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Entisols	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	2-15	Excessively drained	No	A	Low	High	Low	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Andisols	Torrands	Torrands form under shrub and grass vegetation, and are used as irrigated cropland or rangeland.	Very gravelly sandy loam	0-3	Well drained	No	A	Low	High	Low	Low
Andisols	Udands	Udands form primarily under forest vegetation, and are used as cropland, pasture, or forest.	Extremely gravelly loam, Loam, Silt loam, Silty clay loam, Unweathered bedrock	2-90	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Inceptisols	Udepts	Udepts have an udic or perudic (saturated with water long enough to cause oxygen depletion) moisture regime, and are mainly freely drained. Most of these soils currently support or formerly supported forest vegetation, with mostly coniferous forest in the northwest and mixed or hardwood forest in the east. Some also support shrub or grass vegetation, and in addition to being used as forest, some have been cleared and are used as cropland or pasture.	Cobbly loam, Gravelly loam, Loam, Silt loam, Silty clay loam, Unweathered bedrock, Very gravelly loam	0-90	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Alfisols	Ustalfs	Ustalfs are primarily used for grazing or cropland, and also support savanna and grassland vegetation. They are found in areas with a marked dry season.	Very gravelly clay loam	8-30	Well drained	No	B	Medium	Moderate	Medium	Low
Andisols	Vitrands	Vitrands naturally occur in forests, although they can support uses such as rangeland, pastureland, or cropland. They are generally well drained, with a coarse texture and low water content. These soils typically form under coniferous forest vegetation.	Weathered bedrock	0-12	Well drained	No	B	Medium	Moderate	Medium	Low
Alfisols	Xeralfs	Xeralfs support warmer weather, drier vegetation such as annual grasses, forbs, and woody shrubs, along with cooler, wetter vegetation such as coniferous forest. They are typically used for forest, grazing, and croplands.	Cobbly clay loam, Gravelly loam, Loam, Sandy loam, Silty clay loam, Weathered bedrock	0-60	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Andisols	Xerands	Xerands are used as forest, pasture, or cropland. They form under grass and shrub vegetation or under coniferous forest vegetation.	Gravelly sandy loam, Sandy loam, Silt loam, Very gravelly sandy loam	0-60	Somewhat poorly drained to somewhat excessively drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	Low
Inceptisols	Xerepts	Xerepts support coniferous forest, shrubs, grasses, and trees, are typically used for forest, pasture, or croplands, and sometimes as wildlife habitat or rangeland. They are generally freely drained and found in the western United States.	Clay loam, Coarse sandy loam, Cobbly loam, Extremely cobbly silty clay loam, Extremely gravelly coarse sandy loam, Sandy loam, Silt loam, Unweathered bedrock, Very gravelly loam, Very gravelly silt loam, Weathered bedrock	0-80	Moderately well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Vertisols	Xererts	Xererts are found in Mediterranean climates. The soils become very dry in the summer, and most in the winter, which can cause significant damage to roads and structures. They are mostly used for cropland or rangeland, and native vegetation is mainly forbs and grasses.	Clay	30-60	Well drained	No	D	High	Very Low	High	Low

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil ^b	Hydrologic Group	Runoff Potential	Permeability ^c	Erosion Potential	Compaction and Rutting Potential
Mollisols	Xerolls	Xerolls are found on sloping lands that have Mediterranean climates. They are generally freely drained, although typically dry for extended periods in summer. These soils are used for irrigated croplands, and those on very steep slopes are used for rangeland and forest.	Clay, Clay loam, Cobbly clay, Cobbly clay loam, Cobbly loam, Extremely channery loam, Extremely cobbly loam, Extremely stony loam, Extremely stony loamy sand, Extremely stony silty clay loam, Fine sandy loam, Gravelly clay, Gravelly clay loam, Gravelly loam, Gravelly sandy clay loam, Gravelly silt loam, Gravelly silty clay loam, Indurated, Loam, Loamy sand, Sandy loam, Silt loam, Silty clay, Silty clay loam, Stony clay, Unweathered bedrock, Very channery loam, Very cobbly clay, Very cobbly loam, Very cobbly silty clay loam, Very fine sandy loam, Very gravelly clay loam, Very gravelly loam, Very stony clay loam, Very stony loam	0-90	Poorly drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Ultisols	Xerults	Xerults are generally freely drained and support coniferous vegetation. They are used as cropland, pasture, or forest.	Clay loam, Gravelly loam	30-60	Well drained	No	B	Medium	Moderate	Medium	Low

Source: (NRCS, 2015a)

^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, 2015b). 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 7.1.2.5.

7.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.¹⁸ Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 7.1.2-3 provides a summary of the runoff potential for each soil suborder in Oregon.

Group A. Sand, loamy sand or sandy loam soils. This group of soils has “low runoff potential and high infiltration rates¹⁹ 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). Cryands, Psammets, Torrands, and Xerands fall into this category in Oregon.

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. Aquands, Argids, Calcids, Cambids, Cryands, Cryepts, Cryolls, Fluvents, Humults, Orthents, Orthods, Udands, Udepts, Ustalfs, Vitrands, Xeralfs, Xerands, Xerepts, Xerolls, and Xerults fall into this category in Oregon.

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. Albolts, Aquepts, Aquolls, Argids, Cambids, Cryepts, Cryods, Durids, Humults, Orthents, Udands, Udepts, Xeralfs, Xerands, Xerepts, and Xerolls fall into this category in Oregon.

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). Albolts, Aquepts, Aquepts, Aquerts, Aquolls, Argids, Cryands, Durids, Hemists, Orthods, Xeralfs, Xerepts, Xererts, and Xerolls fall into this category in Oregon.

7.1.2.6. 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

¹⁸ 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.

¹⁹ 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 7.1.2-3 provides a summary of the erosion potential for each soil suborder in Oregon. Soils with medium to high erosion potential in Oregon include those in the Albolls, Aquands, Aquents, Aquepts, Aquerts, Aquolls, Argids, Calcids, Cambids, Cryands, Cryepts, Cryods, Cryolls, Durids, Fluvents, Hemists, Humults, Orthents, Orthods, Udands, Udepts, Ustalfs, Vitrand, Xeralfs, Xerands, Xerepts, Xererts, Xerolls, and Xerults suborders, which are found throughout most of the state (Figure 7.1.2-2).

7.1.2.7. 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 (USFS, 2009b). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than ten tons can cause soil compaction of greater than 12 inches 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 7.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Oregon. Soils with the highest potential for compaction and rutting in Oregon include those in the Albolls, Aquents, Aquepts, Aquerts, Aquolls, Hemists, and Orthods suborders, which are found primarily in northern and western areas of the state (Figure 7.1.2-2).

7.1.3. Geology

7.1.3.1. Definition of the Resource

The U.S. Geological Survey (USGS) is the primary government organization responsible for the nation's geological resources. USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability. Several of these elements are discussed in other sections of this PEIS, including Water Resources (Section 7.1.4), Human Health and Safety (Section 7.1.15), and Climate Change (Section 7.1.14).

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

- Section 7.1.3.3, Environmental Setting: Physiographic Regions and Provinces^{20,21}
- Section 7.1.3.4, Surface Geology
- Section 7.1.3.5, Bedrock Geology²²
- Section 7.1.3.6, Paleontological Resources²³
- Section 7.1.3.7, Fossil Fuel and Mineral Resources
- Section 7.1.3.8, Potential Geologic Hazards²⁴

7.1.3.2. 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 7.1.3-1.

Table 7.1.3-1: Relevant Oregon Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
2013 Oregon Revised Statute (ORS) Volume 9 Chapter 358 Section 920 ^a	State of Oregon	A permit is required before excavating, injuring, destroying, or altering an archaeological site or object (including fossils), or removing an object, on any public or private land.
Oregon Building Codes ^b	Oregon Building Codes Division (BCD)	Guidelines on seismic design

^a(State of Oregon, 2013)

^b(Oregon BCD, 2015)

7.1.3.3. 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, in a large proportion of cases, due to differences in the nature or structure of the underlying rocks.” There are eight distinct physiographic regions in the continental United States: 1) Atlantic Plain, 2) Appalachian Highlands, 3) Interior Plains, 4) Interior Highlands, 5) Laurentian Upland, 6) Rocky Mountain System, 7) Intermontane Plateaus, and 8) Pacific Mountain System. Regions are further subdivided into physiographic provinces based on differences observed on a local scale (Fenneman, 1916).

Oregon has three major physiographic regions: Intermontane Plateau (Basin and Range and Columbia Plateau provinces), Pacific Mountain System (Cascade-Sierra Mountains and Pacific Border provinces), and Rocky Mountain System (Northern Rocky Mountains province). The

²⁰ Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology (Fenneman, 1916).

²¹ Physiographic provinces: Subsets within physiographic regions (Fenneman, 1916).

²² Bedrock: Solid rock beneath the soil and superficial rock (USGS, 2015h).

²³ Paleontology: “Study of life in past geologic time based on fossil plants and animals” (USGS, 2015d).

²⁴ 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, 2013b).

locations of these regions are shown in Figure 7.1.3-1 and their general characteristics summarized in the following subsections.

Intermontane Plateau

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).²⁵ Interspersed higher-elevation plateaus, mountains, and lower-lying basins characterize the region. (Lew, A., 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 extension²⁶ 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 Oregon, the Basin and Range Province includes the southern portion of the state, including the City of Klamath Falls.

Columbia Plateau – The Columbia Plateau Province is found in northern and eastern Oregon, including the cities of Bend, La Grande, and Hermiston. The Columbia Plateau is noted for containing widespread Miocene basalt²⁷ fields that date to within the last 17 million years. The plateau is at its lowest elevation along the eastern edge of the Cascade Mountains, and then rises up to the east to more than 2,000 feet in elevation. The Columbia River is located within this province, and is trapped against the Cascade Mountains by the characteristic basalt fields. The Columbia Plateau is generally flanked to the south by the Blue-Ochoco Mountains in central Oregon (Ames, 2015).

²⁵ 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.

²⁶ Extension: “In geology, the process of stretching the Earth’s crust. Usually cracks (faults) form, and some blocks sink, forming sedimentary basins.” (USGS, 2015c)

²⁷ Basalt: “A dark, fine-grained, extrusive (volcanic) igneous rock with a low silica content (40 percent to 50 percent), but rich in iron, magnesium and calcium.” (USGS, 2015c)

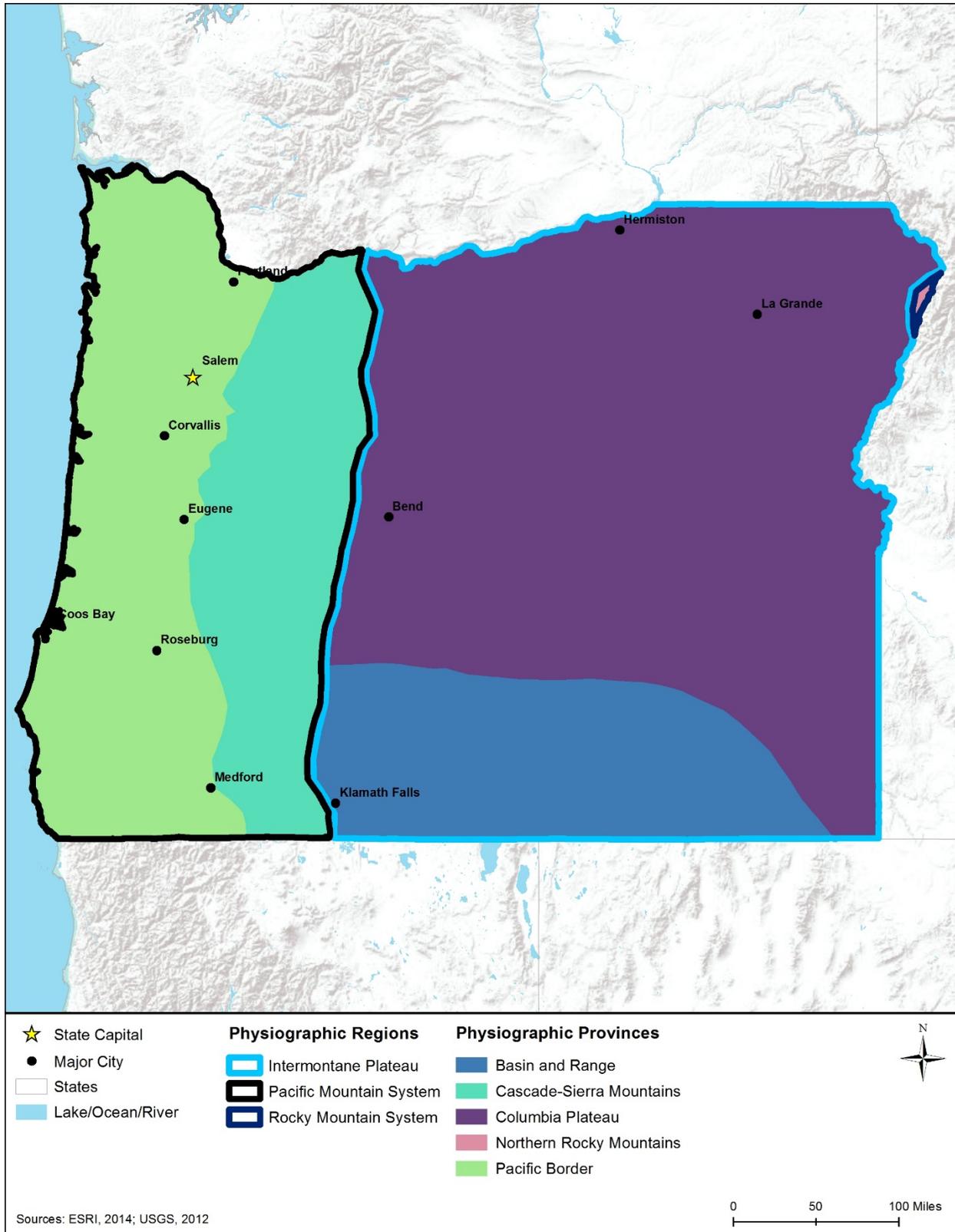


Figure 7.1.3-1: Physiographic Regions and Provinces of Oregon

Pacific Mountain System

The Pacific Mountain System Region describes the area including the Cascade and Sierra Nevada mountain ranges, the Coastal mountain ranges, the valleys in between these mountain ranges, and the Pacific Coast. Peaks in the Cascades and Sierra Nevada mountains rise to over 12,000 feet in elevation, while peaks in the Coastal range's granitic mountains are over 6,000 feet high. The Pacific Coast is an area of volcanic and earthquake activity from tectonic movement. (USGS, 2014b)

Cascade-Sierra Mountains - The Cascade-Sierra Mountains Province is located in western Oregon, running north and south along the Cascade mountain range. This province parallels the Pacific Ocean coastline in an arc shape, and is one of the most tectonically active, and youngest, province in the nation. It is characterized by a mountainous landscape, and includes thousands of short-lived volcanoes that have built up layers of lava and debris; as well as thirteen major volcanic centers (NPS, 2014b).

Pacific Border – The Pacific Border Province is located along the Pacific coastline of Oregon, and includes the lands west of the Cascade Mountains, and south to the Klamath Mountains in southern Oregon. Like the Cascade-Sierra Mountains, the Pacific Border Province is noted for having frequent earthquake activity. Lowlands and mountains on the eastern margin, and coastal areas to the west characterize the Pacific Border Province. (NPS, 2014c)

Rocky Mountain System

The Rocky Mountains form a line from the northern border with Canada south into central New Mexico. The Rocky Mountains were created during the Laramide orogeny,²⁸ which occurred between 70 and 40 MYA. They formed due to the collision of the Pacific Ocean oceanic crust²⁹ with the North American continental crust. In most cases, convergence of oceanic crust with continental crust results in mountain formation 200 to 400 miles from the coastline. However, given the low angle of subduction by which the oceanic crust passed under the less dense continental crust during the Laramide orogeny, the Rocky Mountains occurred several hundred miles further inland than would normally be observed. (USGS, 2014c)

Northern Rocky Mountains Province – The Northern Rocky Mountains includes a small area in northeastern Oregon. This province is not covered in detail, as the area is negligible in Oregon. See Idaho Section 5.1.3.3 for more information on this province.

7.1.3.4. 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

²⁸ Orogeny: “An episode of mountain building and/or intense rock deformation.” (USGS, 2015c)

²⁹ Crust: “The rocky, relatively low density, outermost layer of the Earth.” (USGS, 2015c)

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 2013c)

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).

Surficial deposits in Oregon range from before the Tertiary (approximately 66 to 2.6 million years ago) to the Holocene Epoch (11,700 years ago to present) in age. Deposits also range in grain size, with coarse-grained, younger deposits mostly from glacial or stream origins, as well as fine-grained deposits that are older and have volcanic, lake, or eolian (wind-blown) origins (USGS, 1994a). Much of Oregon is covered by sand, silt, clay, and gravel. Surface materials in the Cascade Mountains include basalt, andesite, and scoria. Many areas of broken rock and soil also exist in the state, resulting in a high potential for landslides (Oregon Department of Geology and Mineral Industries, 2009). Figure 7.1.3-2 depicts the main surficial composition of Oregon.

7.1.3.5. Bedrock Geology

Bedrock geology analysis, and “the study of distribution, position, shape, and internal structure of rocks” (USGS, 2015b) reveals important information about a region’s surface and subsurface characteristics (i.e., three-dimensional geometry), including dip (slope of the formation),³³ rock composition, and regional tectonism³⁴. 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).

Oregon bedrock is mostly composed of sedimentary and volcanic rocks that are thousands of feet thick. This bedrock ranges in age between 60 million and two million years. Sedimentary rocks are generally found in western Oregon, along the coastline, where marine deposits have accumulated over millions of years. Basalt volcanic rocks created by ancient volcanoes and hot spots that created enormous lava flows mostly cover the rest of the state. Most notably is the Yellowstone Hot Spot that occurred between 17 and 15 million years ago and covered much of eastern Oregon with what is now known as the Columbia River Basalt (Oregon Department of Geology and Mineral Industries, 2009). Figure 7.1.3-3 shows the general bedrock geology for Oregon. Additional Oregon bedrock geology information is available from the Oregon Department of Geology and Mineral Industries at (www.oregongeology.org/sub/default.htm).

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 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)

³⁴ Tectonism: “Structure forces affecting the deformation, uplift, and movement of the earth’s crust.” (USGS, 2015c)

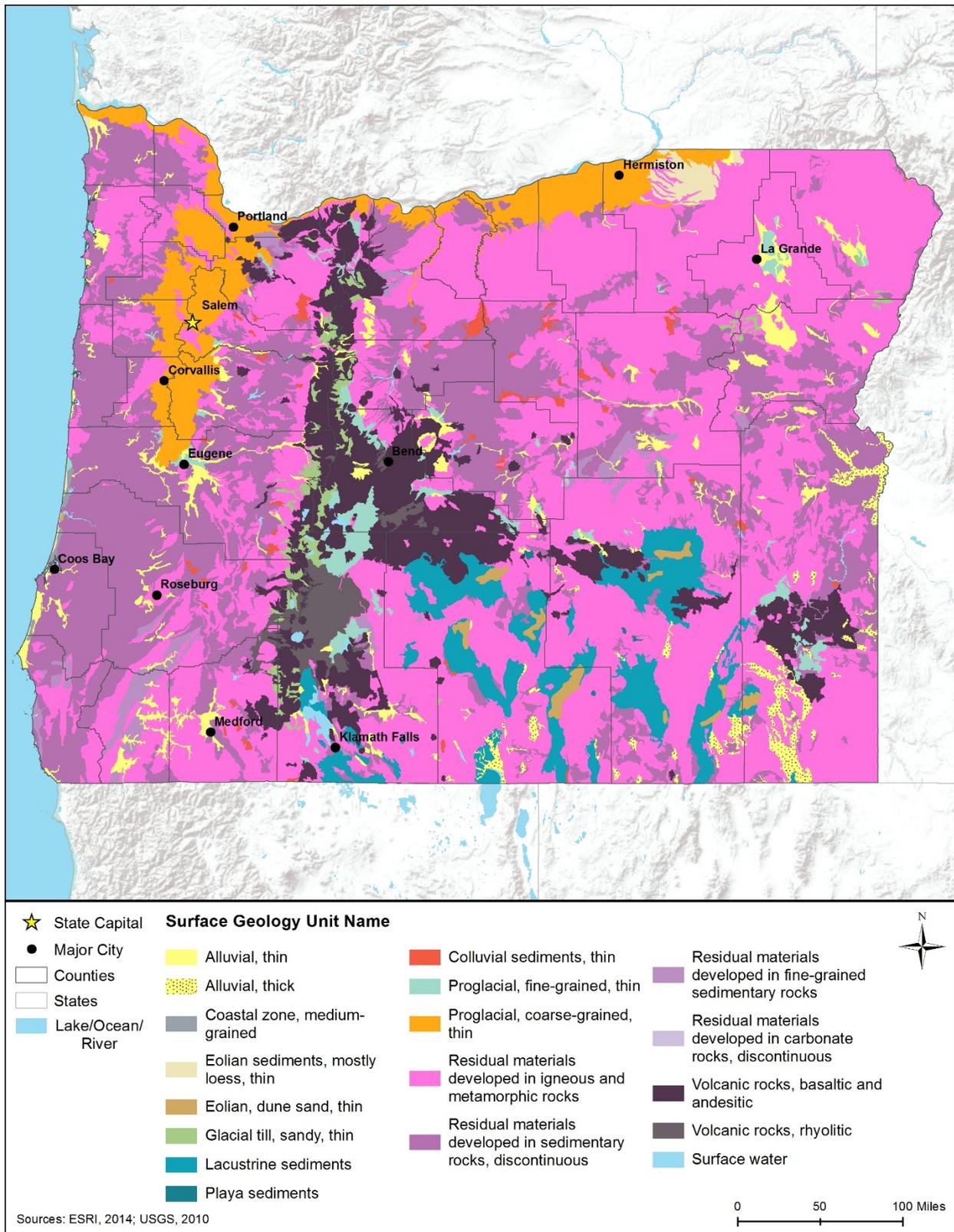
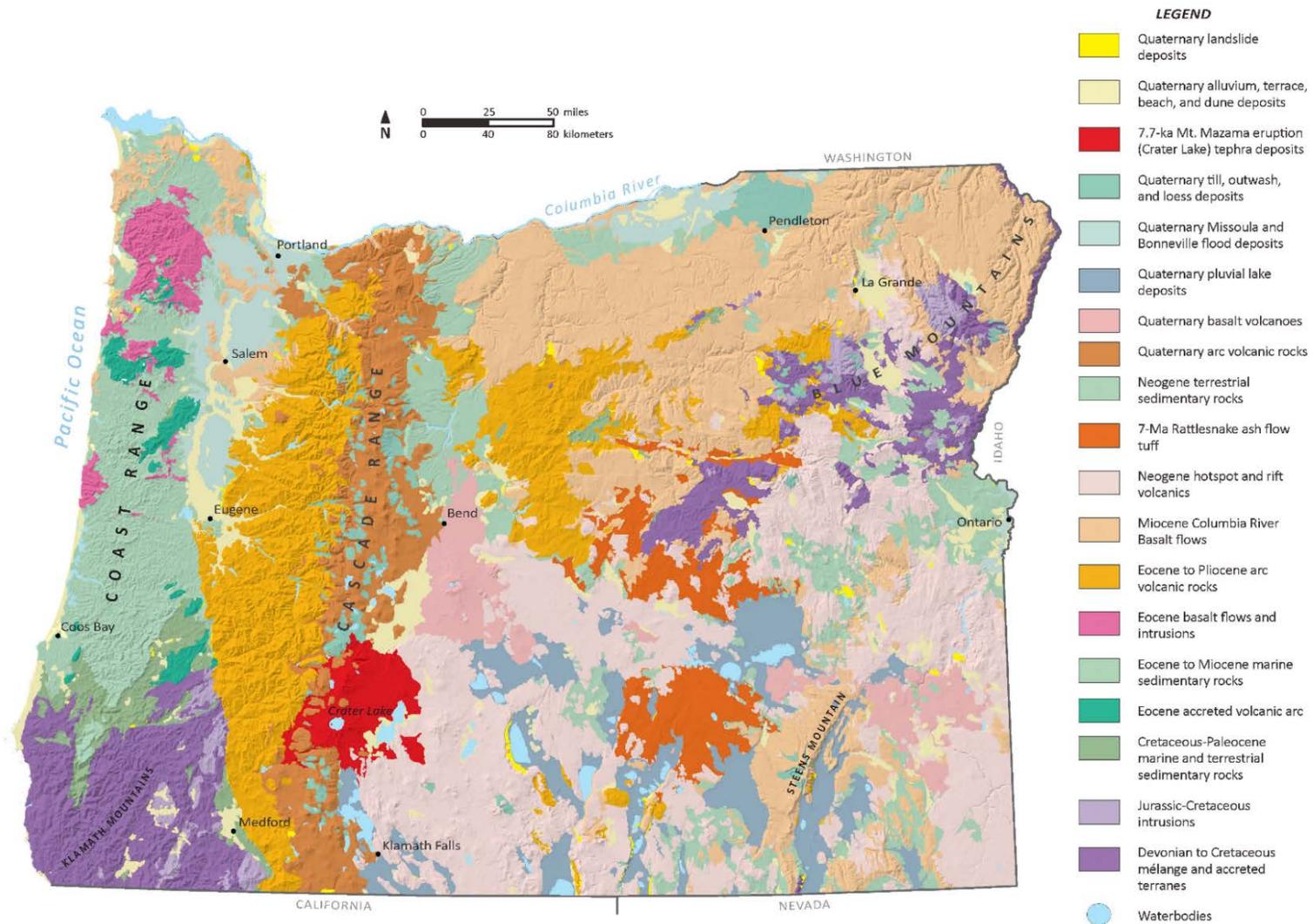


Figure 7.1.3-2: Generalized Surface Geology for Oregon



Source: (Oregon Department of Geology and Mineral Industries, 2015a)

Figure 7.1.3-3: Generalized Bedrock Geology for Oregon

7.1.3.6. *Paleontological Resources*

During the Paleozoic (542 to 251 MYA) Era, from the Devonian (416 to 359 MYA) Period through the Permian (299 to 251 MYA) Period, Oregon was a tropical island. Limestones from this period yield fossils of corals, brachiopods,³⁵ and marine invertebrates. During the Mesozoic (251 to 66 MYA) Era, shallow seas remained, covering the majority of the state. Marine fossils from snails, corals, and oysters can be found in sediments from this time, along with fragments of vertebrate fossils from pterosaurs and ichthyosaurs. The early Cenozoic (66 MYA to present) Era continued with warm, shallow seas over areas of Oregon, with fossils of turret and fig shells recorded. As the climate cooled, forests started to cover the state, with mammals including bears, deer, dogs, cats, horses, and camels, as well as early elephants, rhinoceroses, and bear-dogs (Paleontology Portal, 2015). The *Metasequoia*, the state fossil of Oregon, is a redwood that lived in Oregon during the Miocene (23 to 5.3 MYA) Epoch and can be found in rocks throughout the state (Oregon Secretary of State, 2015c). During the Pleistocene (2.6 MYA to 11,700 years ago) Epoch, glaciers covered the mountainous areas of the state, while a range of environments such as forest, savanna, and arid plains covered the coastal and lowland regions. Fossils of bighorn sheep, mammoths, and ground sloths have been recorded in Oregon from this period (Paleontology Portal, 2015).

Oregon State Fossil *Metasequoia*



Source: (Oregon Secretary of State, 2015c)

7.1.3.7. *Fossil Fuel and Mineral Resources*

Oil and Gas

Oregon has no crude oil production, nor does the state have any crude oil reserves. The state receives crude oil via pipelines and barges. Oregon has minimal natural gas production. Natural gas production began in 1979, and the state's only producing natural gas field is the Mist Field, in the northwest part of the state. In 2014, Oregon produced 950 million cubic feet of natural gas, ranking twenty-seventh nationwide (EIA, 2015c).

Minerals

As of 2015, Oregon's nonfuel mineral production values was \$398M, which ranked thirty-sixth in nationwide (in terms of dollar value). As of 2015, leading nonfuel minerals in Oregon were crushed stone, construction sand and gravel, portland cement, diatomite, and crude perlite (USGS, 2016a). As of 2015, Oregon was the only state producing chromite and emery, and it was ranked first in pumice production nationwide. Other minerals produced in the state are bentonite, common clay and shale, diatomite, gemstones, pumice, talc, zeolites, emery, niobium and tantalum, steel, titanium metal, volcanic cinder, and zirconium (USGS, 2016a).

³⁵ 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)

7.1.3.8. Geologic Hazards

The four major geologic hazards of concern in Oregon are volcanoes, earthquakes, landslides, and subsidence. A discussion of each geologic hazard is included below.

Volcanoes

Volcanic hazards in Oregon can be found in southeastern Oregon, central Oregon, and particularly along the Cascade Mountain Range (Figure 7.1.3-4). The volcanoes in the Cascade Mountain Range are formed from tectonic plates interacting along the Cascadia Subduction Zone. As the Juan de Fuca plate sinks underneath the North American plate, it begins to melt, creating magma chambers far beneath the mountains. This activity produces explosive eruptions that are difficult to predict. Figure 7.1.3-4 displays volcanoes in the Cascade Mountain Range. Not all have been recently active; Mount Hood is the only major volcano to erupt in the last 200 years. However, impacts from volcanoes can occur throughout the state. Hazards from volcanoes include ashfall, lava³⁶ flows, pyroclastic (“fire-broken”) flows,³⁷ landslides, earthquakes, and flooding. The Counties of Clackamas, Douglas, Deschutes, Hood River, Jackson, Jefferson, Klamath, Lane, Linn, Marion, Multnomah, and Wasco are the most vulnerable to volcanic hazards. (State of Oregon, 2015a)

Earthquakes

Between 1974 and 2003, there were approximately eight earthquakes of a magnitude 4.5 (on the Richter scale) or greater in Oregon (USGS, 2014d). 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).

³⁶ Lava: “Magma that reaches the Earth’s surface through a volcanic eruption. When cooled and solidified, forms extrusive (volcanic) igneous rock.” (USGS, 2015c)

³⁷ Pyroclastic Flow: “A volcanic eruption that produces a large volume of solid volcanic fragments (pyroclastics) rather than fluid lava. This type of eruption is typical of volcanoes with high silica, viscous, gas-rich magma.” (USGS, 2015c)

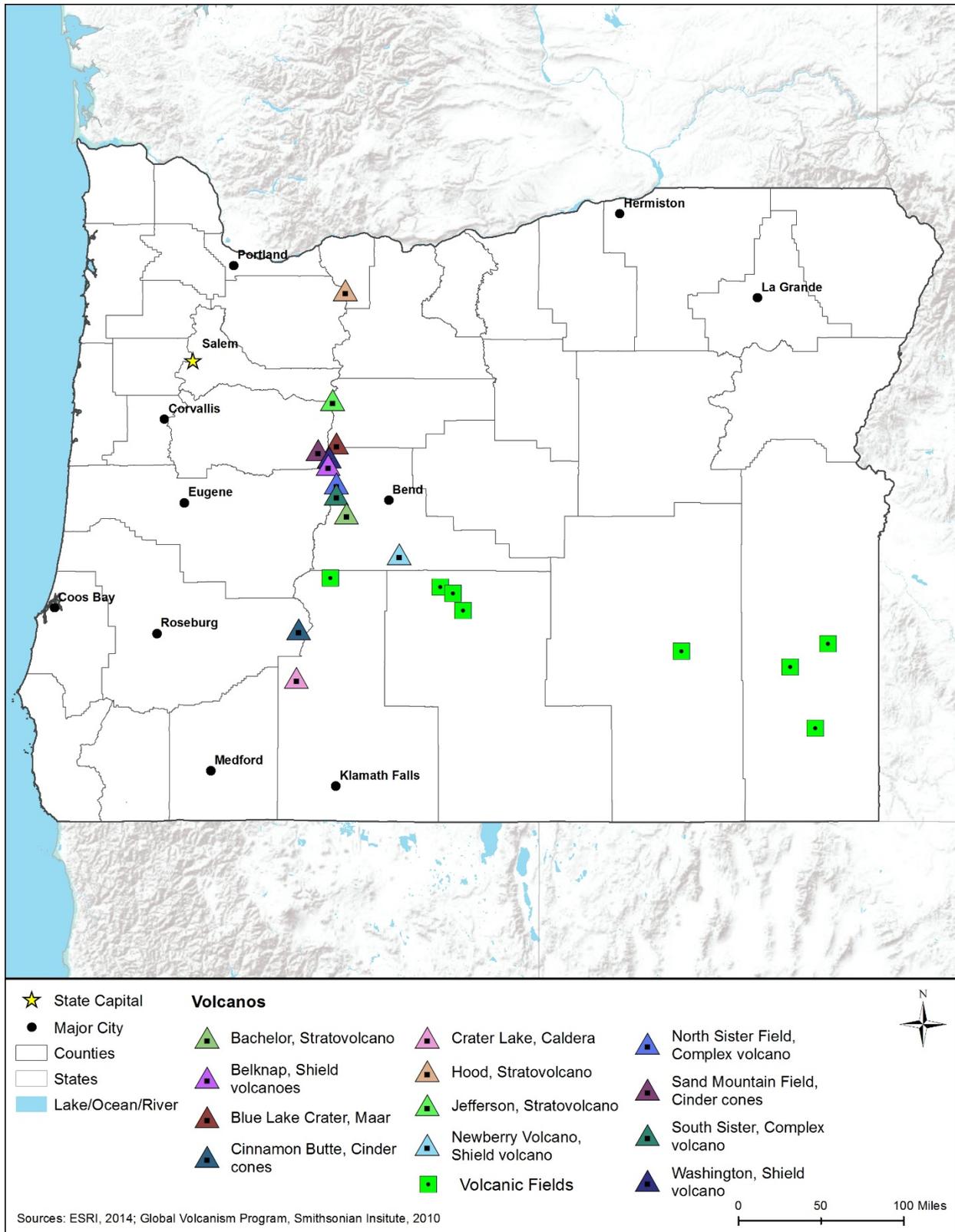


Figure 7.1.3-4: Volcanic Hazards

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.³⁸ Subduction zone earthquakes occur where Earth's tectonic plates collide. "When tectonic plates collide, one plate slides beneath the other, where it is reabsorbed into the mantle of the earth" (Oregon Department of Geology and Mineral Industries, 2015e). Subduction zones are found off the coast of Washington, Oregon, and Alaska (USGS, 2014e). Convergence boundaries between two tectonic plates can result in earthquakes with magnitudes that exceed 8.0 on the Richter scale (Oregon Department of Geology and Mineral Industries, 2015e).

Figure 7.1.3-5 depicts the seismic risk throughout Oregon; 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 (percent g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 percent g. (USGS, 2010)

Earthquakes that have occurred, or are likely to occur, in Oregon, include volcano-induced earthquakes, as well as intraplate,³⁹ crustal, and subduction zone earthquakes. Of these, a subduction zone earthquake is the greatest threat, and in particular, a Cascadia Subduction Zone event, that would cause catastrophic damage and loss of life. In the Cascadia Subduction Zone, "the Juan De Fuca plate, located offshore of Oregon and Washington, slides to the northeast and under the North American plate, which extends from the Oregon coast clear to the middle of the Atlantic Ocean." As such, western Oregon is the most susceptible to this type of earthquake, including the populated areas of Portland, Eugene, and Salem (State of Oregon, 2015a). The most destructive earthquake ever recorded (in terms of property damage) occurred in Scotts Mills, southeast of Portland, on March 25, 1993 and measured magnitude 5.6 on the Richter scale (Oregon Department of Geology and Mineral Industries, 2015b).

³⁸ The Richter scale is a numerical scale for expressing the magnitude of an earthquake on the basis of seismograph oscillations. The more destructive earthquakes typically have magnitudes between about 5.5 and 8.9; the scale is logarithmic and a difference of one represents an approximate thirtyfold difference in magnitude (USGS 2014h).

³⁹ Intraplate earthquake: "occur within the remains of the ocean floor that is being subducted beneath North America" (Oregon Department of Geology and Mineral Industries, 2015c).

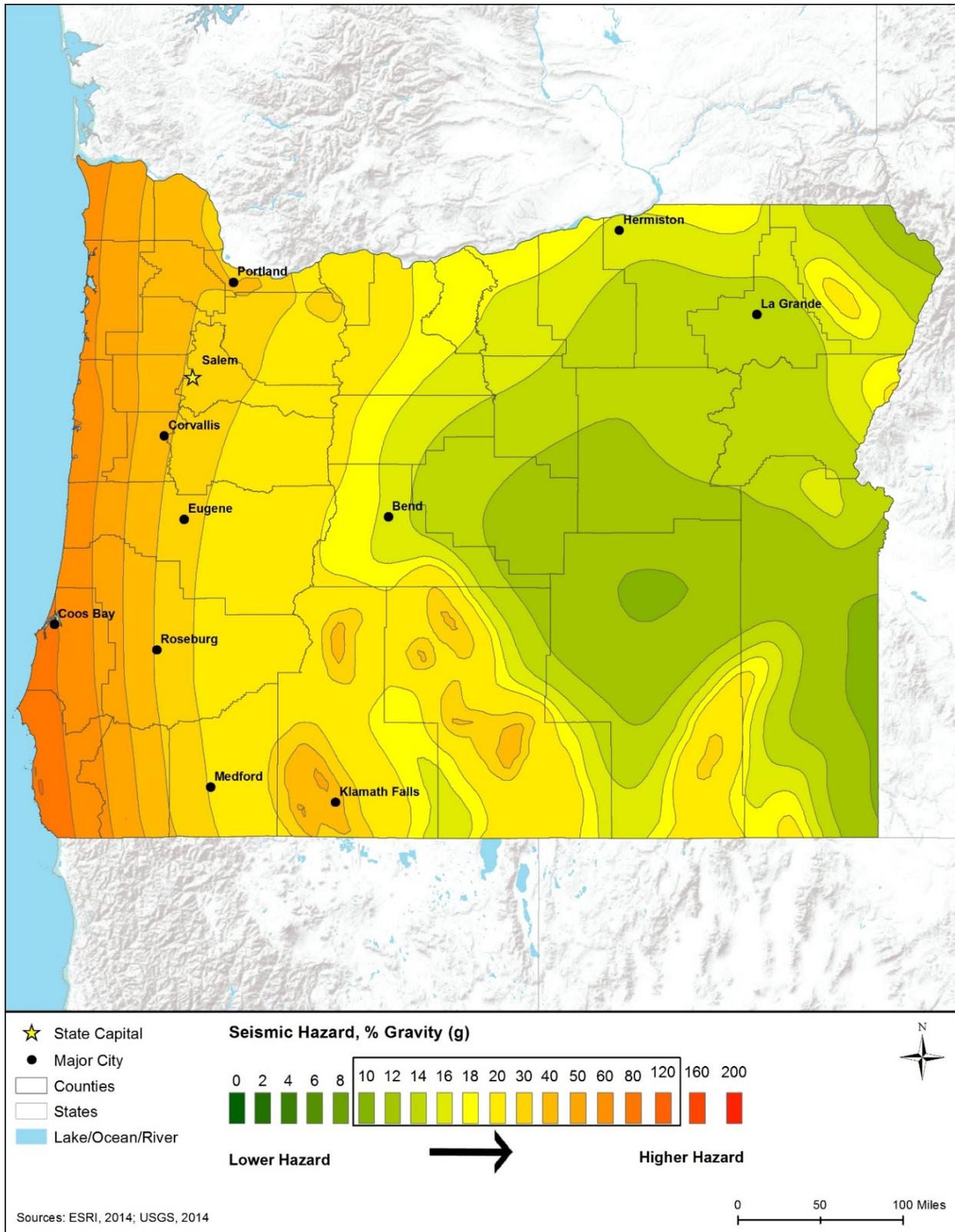


Figure 7.1.3-5: Oregon 2014 Seismic Hazard Map

Landslides

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

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

Although landslides can occur anywhere in Oregon, areas with weak geology, steep slopes, and high annual precipitation are the most vulnerable. These areas include the Cascade Mountains, the Coast Range Mountains, and the coast. Counties with the highest risk of landslides include Clackamas, Linn, Douglas, Coos, Lane, Tillamook, Multnomah, Benton, Jackson, Clatsop, Lincoln, Marion, Washington, Curry, Columbia, Hood River, and Yamhill (State of Oregon, 2015a). Figure 7.1.3-6 shows landslide incidence and susceptibility throughout Oregon.

Subsidence

Land subsidence is a “gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials.” 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 layers of silt or clay, which do not transport groundwater, confine an aquifer, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

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

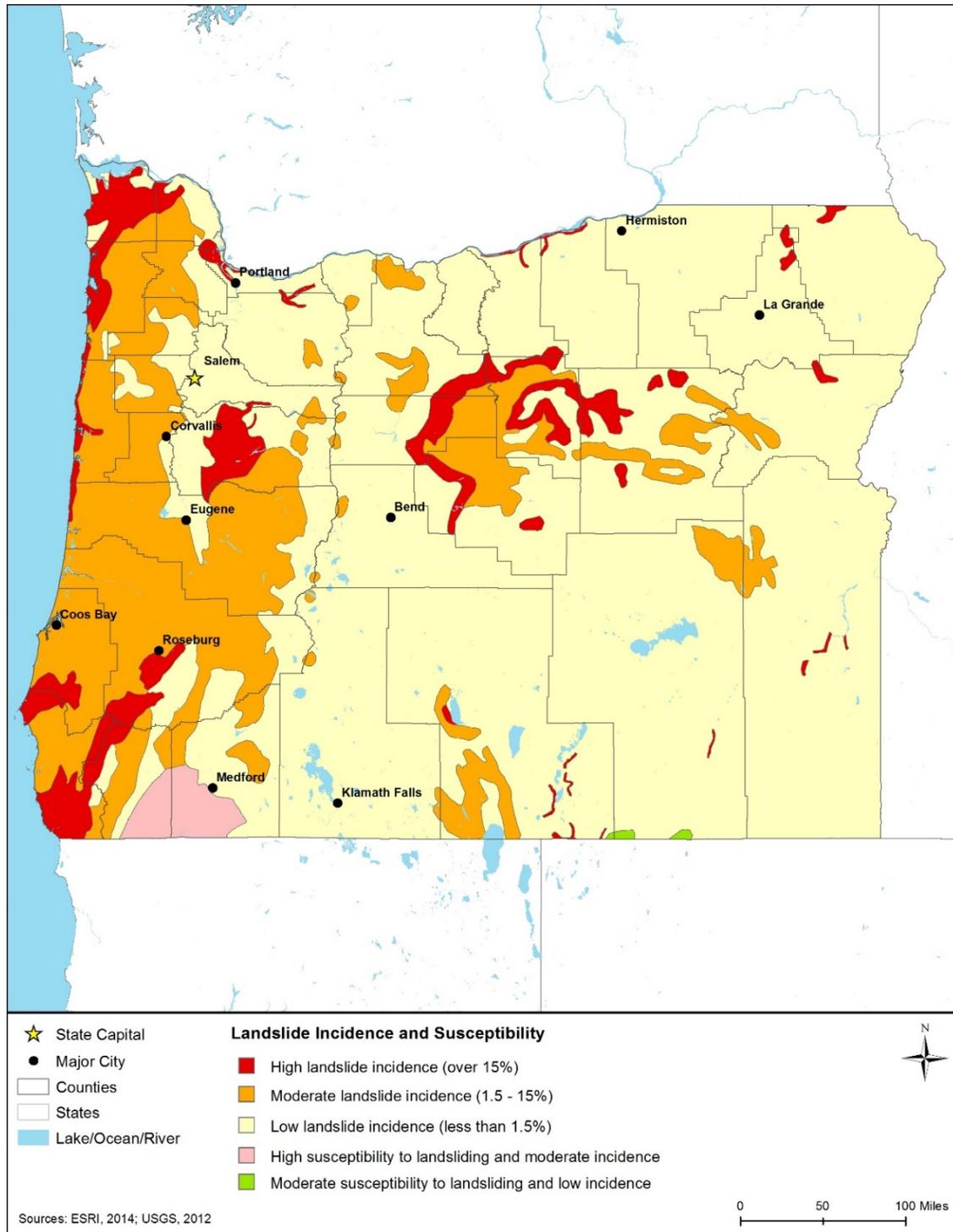


Figure 7.1.3-6: Oregon Landslide Incidence and Susceptibility Hazard Map⁴⁰

⁴⁰ Susceptibility hazards not indicated in Figure 7.1.3-6 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 2014i)

In Oregon, land subsidence can be a concern, particularly in central Oregon (USGS, 2012b). This area contains regions of late Cenozoic (66 MYA to present) Era basalt lava fields that produce volcanic pseudokarst⁴¹ areas. Fissures, open sinkholes, lava tubes, and caves that are created from extrusion of still-liquid portions of lava characterize these regions. Lava tubes and fissures can produce sinkholes mostly less than 100 feet wide, and these pseudokarst areas cause problems to foundations, abutments, and reservoirs, and the permeable lava can hold large quantities of water that can lead to flooding and slope stability issues during excavations and cuts (Davies, 1984). Figure 7.1.3-7 shows the location of areas in Oregon that are susceptible to land subsidence due to karst topography.

⁴¹ Pseudokarst: “karstlike terrain produced by processes other than the dissolution of rocks” (Davies, 1984).

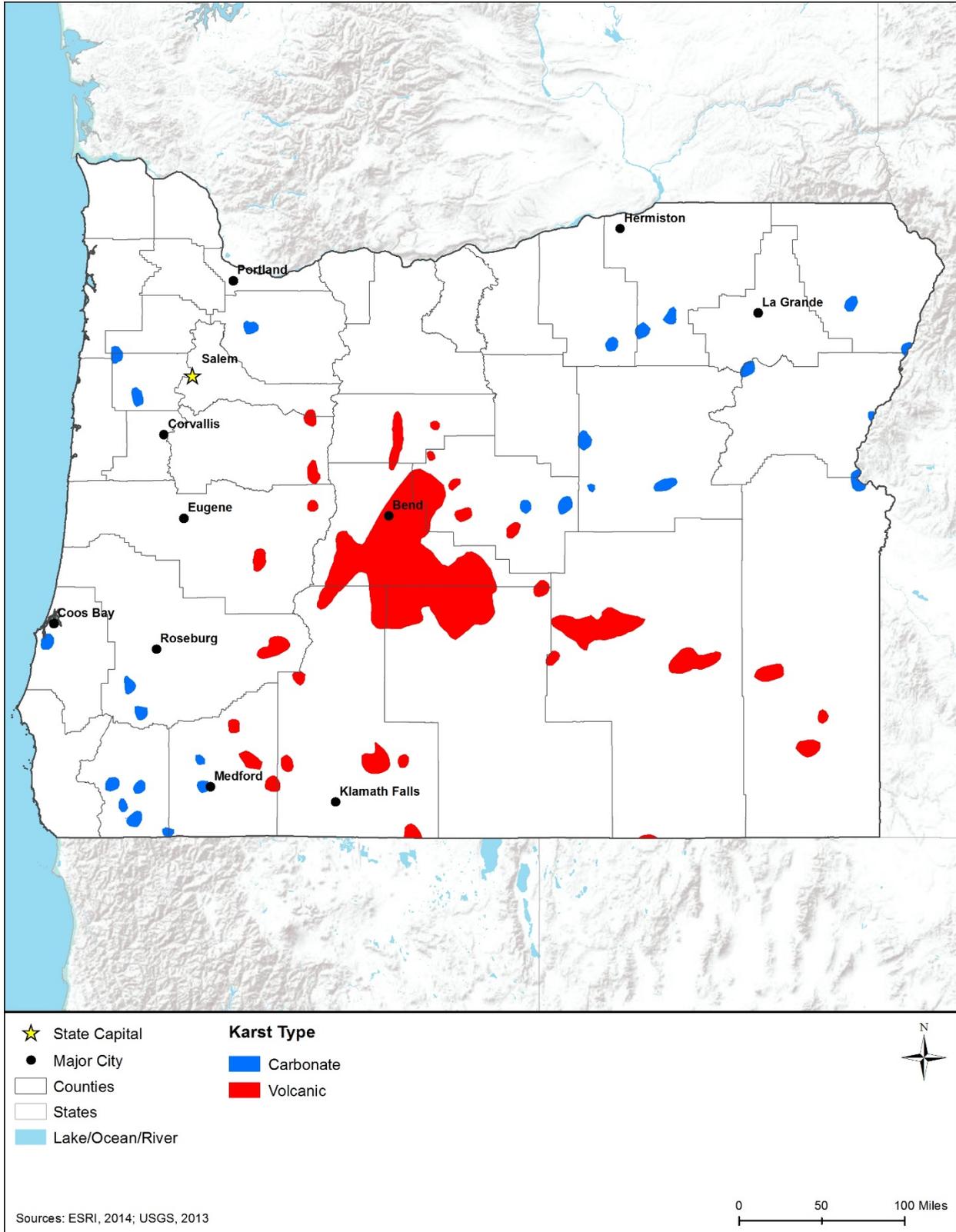


Figure 7.1.3-7: Areas Susceptible to Subsidence due to Karst Topography in Oregon

7.1.4. Water Resources

7.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, canals, ditches, estuarine waters, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 7.1.5). These resources can be grouped into watersheds, which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health. (USGS, 2014f)

7.1.4.2. 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 7.1.4-1 identifies the relevant laws and regulations for water resources in Oregon.

Table 7.1.4-1: Relevant Oregon Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
ORS 537.110, Public ownership of waters	Oregon Water Resources Department	Overarching Oregon law that provides that “[a]ll water within the state from all sources of water supply belongs to the public. In almost every instance, a permit, or water right certificate from the Water Resources Department is needed before using, diverting, or storing water.
Clean Water Act (CWA) Section 401 permit	Oregon Department of Environmental Quality (ODEQ)	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 DEQ indicating that the proposed activity will not violate water quality standards. (Oregon DEQ, 2015e)
Oregon NPDES program	ODEQ	A DEQ-approved construction stormwater general permit must cover construction site operators if they are engaged in construction activities that disturb one or more acres and discharge stormwater to state waters. Sites less than one acre may also require permit coverage if they are part of a larger common plan of development. (Oregon DEQ, 2015f)
Oregon’s Removal-Fill Law	Oregon Division of State Lands (ODSL)	Individuals who remove or fill 50 cubic yards or more in “waters of the state” ⁴² to obtain a permit from the ODSL. In State Scenic Waterways, most removal-fill activities require a permit, regardless of the number of cubic yards affected. (ODSL, 2015a)

⁴² “Waters of the state” are defined as “natural waterways including all tidal and non-tidal bays, intermittent streams, constantly flowing streams, lakes, wetlands and other bodies of water in this state, navigable and non-navigable, including that portion of the Pacific Ocean which is in the boundaries of this state.” (ODSL, 2015a)

State Law/Regulation	Regulatory Agency	Applicability
Oregon Scenic Waterways Act	Oregon Parks and Recreation Department (OPRD)	Written notification is required for certain activities (cutting of trees, mining, construction of roads, railroads, utilities, buildings, or other structures) proposed within proposed within a 1/4 mile of the bank of Oregon’s designated scenic waterways. (Oregon Secretary of State, 2015d)

7.1.4.3. Environmental Setting: Surface Water

Surface water resources are lakes, ponds, rivers, and streams, as well as estuarine⁴³ and coastal waters. Oregon currently has approximately “111,619 stream miles, 1,400 named lakes and an additional 3,800 ponds and reservoirs” (ODSL, 2011a). These surface waters supply drinking water; provide flood control and aquatic habitat; and support recreation, tourism, agriculture, fishing, power generation, and manufacturing across the state. (ODSL, 2011a)

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). Watersheds, or drainage areas, consist of surface water and all underlying groundwater, and encompass an area of land that drains all the streams and rainfall to a common outlet (e.g., reservoir, bay). Oregon’s waters (lakes, rivers, and streams) are divided into 15 major watersheds, or drainage basins (Figure 7.1.4-1); Lower Columbia, North Coast, South Coast, Rogue, Willamette, Umpqua, Deschutes, Klamath, Hood, Umatilla, John Day, Lakes, Grande Ronde, Powder, Malheur-Owyhee.⁴⁴

The Klamath Basin has had drought issues since 2001. “Flowing south from Crater Lake National Park and the Gearhart Wilderness, the streams and springs that form Upper and Lower Klamath lakes exit Oregon into California as the Klamath River” (OWEB, 2011a). The Deschutes Basin is in north-central Oregon, and “includes the high Cascade lakes, wild and scenic waterways, and a rapidly growing human population” (OWEB, 2011b). All streams in the Powder Watershed drain into the Snake River along the border of Oregon and Idaho (OWEB, 2011c). Northwestern Oregon’s Willamette Basin is surrounded by two mountain ranges: the Coast Range to the west, and the Cascade Range to the east (OWEB, 2011d). “The Willamette Valley accounts for more than 70 percent of the state’s population, the majority of its industry, and almost half of its farmland. Most of the state’s major cities (Portland, Salem, Corvallis, and Eugene) are in the Willamette Valley along the Interstate 5 corridor” (Morlan, Blok, Miner, & Kirchner, 2010). Southwestern Oregon’s Rogue River “originates in Crater Lake National Park in the Southern Cascade Mountains... From the lava and pumice of the southern Cascade volcanoes, the middle Rogue River flows through the relatively populated Medford-Ashland area... The Wild and Scenic Rogue River cuts through the Coast Range and enters the Pacific Ocean at Gold Beach” (OWEB, 2011e). The North Coast Basin is composed of eight

⁴³ Estuarine: related to an estuary, or a “partially enclosed body of water where fresh water from rivers and streams mixes with salt water from the ocean. It is an area of transition from land to sea.” (USACE - Portland, 2015)

⁴⁴ For information and additional maps about each watershed’s location, size, and water quality see (www.oregon.gov/OWEB/pages/biennialreport_0911/basin_reports_main.aspx).

unobstructed tributaries to the Pacific Ocean (OWEB, 2011f). The South Coast Basin is in southwestern Oregon and contains the following streams: Cooss, Coquille, Chetco, and Pistol Rivers, and Floras, Sixes, Elk, Winchuck, and Hunter Creeks (OWEB, 2011i).

Freshwater

As shown in Figure 7.1.4-1, there are five major rivers in Oregon: Columbia, Deschutes, Willamette, John Day, and Snake. The Columbia River is the largest river in the region. The river begins in British Columbia, Canada, flows more than 1,200 miles, and drains into the Pacific Ocean. Portions of seven states drain into the river: Idaho, Oregon, Washington, Nevada, Montana, Utah, and Wyoming. (Lower Columbia Estuary Partnership, 2015) The Deschutes River is a north-flowing tributary to the Columbia River and supports trout and steelhead fisheries. “Bull trout and steelhead are listed under the federal Endangered Species” Act (OWEB, 2011b). The Willamette River, the 13th largest river in the United States in terms of stream flow, is a northward flowing major tributary to the Columbia River (Morlan, Blok, Miner, & Kirchner, 2010). The John Day River is the third longest undammed rivers in the United States. The main stem of the river flows north into the Columbia River at the eastern edge of the Columbia River Gorge (OWEB, 2011g) (OWEB, 2011h). “Draining south and east from the Blue Mountains, the Powder and Burnt rivers flow to the middle Snake River... Bull trout in [the Powder River Basin] are listed as ‘threatened’ under the federal Endangered Species Act” (OWEB, 2011c).

Oregon’s Crater Lake is the deepest lake in the United States and the seventh deepest in the world. Since the lake is isolated from surrounding streams and rivers and has no inlet or outlet to the lake, it was filled from precipitation. This process took approximately 250 years for the lake to fill to the current level; the average depth of the lake is 1,148 feet. Precipitation maintains the lake’s current level. The lake’s isolation from streams and rivers also leads to its known clarity. There is no incoming stream to bring any organic materials, sediments, or chemical pollutants to the lake. (Oregon Explorer, 2015)

Upper Klamath Lake is the largest freshwater lake west of the Rocky Mountains. The lake is nearly 30 miles long and up to eight miles wide, with a surface area of 91,000 acres (Bureau of Reclamation, 2015d). Upper Klamath Lake is shallow; 92 percent of the lake is less than 13.1 feet deep. “The 4 percent of the area of the lake that is greater than [16.4 feet] depth is found in a narrow trench along the lake’s western shore” (USGS, 2013b).



Figure 7.1.4-1: Major Oregon Watersheds and Surface Waterbodies

Estuarine and Coastal Waters

Estuaries (including bays and tidal rivers) are bodies of water that provide transition zones between fresh river water and saline ocean water. Barrier islands, sand bars, and other landmasses protect estuaries, including those in Oregon, from ocean waves and storms. Estuarine environments support a variety of habitats, including tidal wetlands, mudflats, rocky shores, oyster reefs, freshwater wetlands, sandy beaches, and eelgrass beds, and are a critical part of the lifecycle of many different plant and animal species (USEPA, 2015a).

Along Oregon's 362-mile coastline,⁴⁵ "there are 22 major estuaries and many other minor estuaries. Most of the larger estuaries have been altered through dredging, filling, or diking... Twenty-two cities, seven counties, and thirteen port districts have planning or management responsibilities for Oregon's major estuaries" (OCMP, 2015). Oregon's estuarine management program classifies estuaries based on the level of development permitted in each waterbody. (OCMP, 2015)

- "Natural estuaries lack maintained jetties or channels, and are usually little developed for residential, commercial, or industrial uses. They may have altered shorelines, provided that these altered shorelines are not adjacent to an urban area. Shorelands around natural estuaries are generally used for agriculture, forestry, recreation and other rural uses" (OCMP, 2015). Examples include Sand Lake, Salmon River, Elk River, Sixes River, and Pistol River.
- "Conservation estuaries lack maintained jetties or channels, but are within or adjacent to urban areas which have altered shorelines adjacent to the estuary" (OCMP, 2015). Examples include Necanicum River, Netarts Bay, Nestucca River Siletz Bay, Alsea Bay, and Winchuck River.
- "Shallow draft development estuaries [have] maintained jetties and a main channel (not entrance channel) maintained by dredging at 22 feet or less" (OCMP, 2015). Examples include Nehalem Bay, Tillamook Bay, Depoe Bay, Siuslaw River, Umpqua River, Coquille River, Rogue River, and Chetco River.
- "Deep draft development estuaries [maintain] jetties and a main channel [by] dredging to deeper than 22 feet" (OCMP, 2015). Examples include Columbia River, Yaquina Bay, and Coos Bay. (OCMP, 2015)

Oregon has two major estuaries that are managed by federal and state agencies along its coast (Figure 7.1.4-2).

- The Lower Columbia River Estuary stretches between Oregon and Washington along the Pacific Coast and upriver to Bonneville Dam. In 1995, the USEPA National Estuary Program recognized the Lower Columbia River Estuary as an Estuary of National Significance (Lower Columbia Estuary Partnership, 1999). The Lower Columbia River Estuary's Comprehensive Conservation and Management Plan (CCMP) update identified 17 actions. Water quality and contaminant reduction actions were expand and sustain regional monitoring of toxic and conventional pollutant, reduce conventional pollutants, and cleanup reduce, or eliminate toxic contaminants, particularly contaminants of regional concern.

⁴⁵ Various websites provide different estimates for the length of Oregon's coastline. The 362-mile figure was chosen from the Oregon Parks and Recreation Department: <https://www.oregon.gov/oprd/RULES/pages/oceanshores.aspx>.

(Lower Columbia Estuary Partnership, 2011) For more information on the Lower Columbia River Estuary and CCMP, see (<http://water.epa.gov/type/oceb/nep/index.cfm#tabs-2>).

- Another important estuary is the South Slough National Estuarine Research Reserve (NERR), in southern Oregon in the South Coast Basin. The mission of the South Slough NERR is to improve the understanding and stewardship of Pacific Northwest estuaries and coastal watersheds. South Slough was the first designated of 28 areas in the NERR System. This reserve is managed by the Oregon Division of State Lands and is protected for long-term research, water-quality monitoring, education, and coastal stewardship. This reserve and its watershed protect upland (forests) and lowland habitats (freshwater wetlands and ponds). (NOAA, 2015a)

7.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Portions of 49 rivers in Oregon totaling 1,916.7 miles, have been designated National Wild and Scenic Rivers (see Appendix C, Environmental Laws and Regulations, for more information on the National Wild and Scenic Rivers Act) (National Wild and Scenic Rivers System, 2015a). Oregon Appendix A, Table A-1 Oregon Federal Wild, Scenic, and Recreational Rivers, identifies each of these rivers.

As a land management tool, the Oregon Scenic Waterways Program was established in 1970 to give the Oregon Parks and Recreation Department (OPRD) the authority to protect and enhance values of identified scenic waterways with emphasis on various attributes that include scenic beauty (Oregon Secretary of State, 2015d). Twenty rivers and river segments are designated scenic waterways by the Oregon Scenic Waterways Program.

7.1.4.5. Impaired Waterbodies

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under Section 404(d) of the Clean Water Act, states are required to assess water quality and report a listing of impaired waters,⁴⁶ the causes of impairment, and probable sources. Table 7.1.4-2 summarizes the water quality of Oregon's assessed major waterbodies by category, percent impaired, designated use,⁴⁷ cause, and probable sources. Figure 7.1.4-2 shows the Section 404(d) waters in Oregon as of 2014.

As shown in Table 7.1.4-2, various sources affect Oregon's waterbodies, causing impairments. As of 2006 more than half of the assessed river and streams, lakes and estuaries, and coastal waters in the state are impaired. Causes of impairment include temperature, sediment/siltation, nutrients, habitat modification, and fecal coliform. No probable sources for impairment were reported at the time of the last assessment report. (USEPA, 2006)

⁴⁶ Impaired waters: waterways that do not meet state water quality standards. Under the CWA, Section 404(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters. (USEPA 2015r)

⁴⁷ 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 2015r)

Table 7.1.4-2: Section 404(d) Impaired Waters of Oregon, 2006

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	40%	67.5%	aesthetic quality, aquatic life, drinking water, recreation, and fishing	temperature, nutrients, sediment, and pH/acidity	no probable sources reported
Lakes, Reservoirs, and Ponds	22%	97%	aesthetic quality, aquatic life, fishing, and human health	organic enrichment, habitat alterations, and sediment	no probable sources reported
Pacific Ocean coastal shoreline	5.0 miles (total assessed shoreline miles unknown)	80%	shellfish growing	fecal coliform	no probable sources reported

Source: (USEPA, 2006)

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

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

In 2011, Oregon DEQ began conducting in-depth assessments of the state’s basins on a rotating basis (evaluating a few basins per year). These assessments evaluate local water quality status and action plans, which describe water quality conditions and include recommendations for actions that Oregon DEQ can take to improve water quality. DEQ’s 2014 summary report found that water quality status and trends were improving for Oregon’s rivers. “Overall, 51 percent of river sites monitored were found to have excellent to good water quality status. Over the previous ten years, 30 percent of the sites have improving trends, 3 percent have worsening trends, and 67 percent have non-changing trends.” (Oregon DEQ, 2015g)

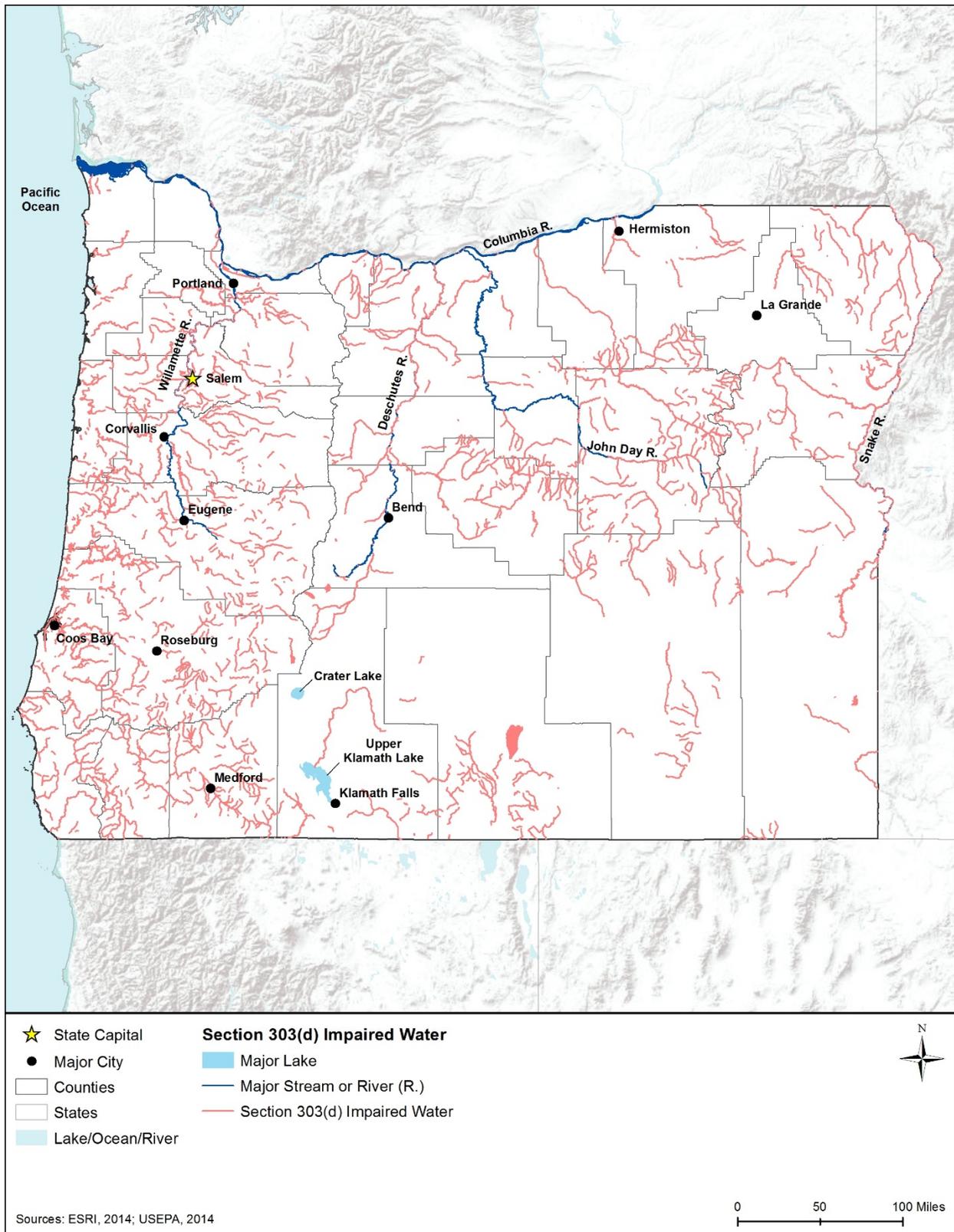


Figure 7.1.4-2: Section 404(d) Impaired Waters of Oregon, 2014

7.1.4.6. *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).⁴⁸ Through FEMA’s flood hazard mapping program, the agency identifies flood hazards and risks associated with the 100-year flood, which is defined as “a flood that has a 1 percent chance of occurring in any given year,” to allow communities to prepare and protect against flood events (FEMA, 2013).

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

There are two primary types of floodplains in Oregon.

- **Riverine floodplains** occur along rivers and streams, 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, 2014c). “Almost every county in Oregon experiences riverine flooding. In fact, Oregon has over 250 flood-prone communities. The danger of riverine flooding occurs mainly during the winter months, with the onset of persistent, heavy rainfall, and during the spring, with the melting of snow in the Cascade and Coast Ranges. Most of Western Oregon is highly susceptible to riverine flooding, especially Coos, Tillamook and Columbia Counties, as well as the western drainages of the Cascade Range” (ODLCD, 2000).
- **Coastal floodplains** occur in areas where strong wind and storms increase water levels on the adjacent shorelines (FEMA, 2013). In addition, a storm surge event that takes place during high tide can cause floodwaters to exceed normal tide levels, resulting from strong winds preventing tidal waters to recede in conjunction with additional water pushed toward the shore.

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015b). Oregon’s deadliest recorded flood occurred in Heppner (northeastern Oregon) in 1903, when a storm “dropped 1.5 inches of

⁴⁸ To search for and locate CFR records, see the Electronic Code of Federal Regulations (e-CFR): www.ecfr.gov.

rain within a 20-minute period...Within minutes, a 5-foot wall of water and debris poured through Heppner with enough velocity to rip homes off of their foundations. These floodwaters claimed 247 lives.” (ODLCD, 2000)

Another type of flooding that can occur within Oregon is playa flooding, which results from greater than normal runoff into a closed basin (systems that have one or more rivers emptying into it but no outlet other than evaporation). If precipitation in the closed basin increases faster than the water can evaporate, then the playa lake levels will rise and flood the surrounding areas. An example of playa-basin flooding in Oregon occurred at Malheur and Harney Lakes in Harney County. In higher than average precipitation years, the lakes flood adjacent ranches and public roads. Malheur and Harney Lakes flooded during the years 1979 to 1986, and then gradually receded. Then during the wetter years of 1997 to 1999, these lakes again flooded. (ODLCD, 2000)

Local communities often have floodplain management or zoning ordinances that restrict development within the floodplain. FEMA provides floodplain management assistance, including mapping of 100-year floodplain limits, to approximately 260 communities in Oregon through the National Flood Insurance Program (NFIP) (FEMA, 2014b). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities “to adopt and enforce floodplain management regulations and to implement broader floodplain management programs” and allows property owners in participating communities to purchase insurance protection against losses from flooding (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System (CRS), which is a program that rewards communities by reducing flood insurance premiums in exchange for doing more than the minimum NFIP requirements for floodplain management. As of May 2014, Oregon had 34 communities participating in the CRS (FEMA, 2014d).⁴⁹

7.1.4.7. Groundwater

Groundwater systems are sources of water that result from precipitation infiltrating the ground surface. It 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.

⁴⁹ A list of the 28 CRS communities can be found in the most recent FEMA CRS report dated May 1, 2014 (FEMA, 2014e) and additional program information is available from FEMA’s NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

Oregon's principal aquifers consist of igneous and metamorphic-rock aquifers⁵⁰, sand and gravel aquifers of alluvial and glacial origin,⁵¹ and unconsolidated sand and gravel aquifers.

Approximately 70 percent of Oregon residents get their drinking water from groundwater, and over 90 percent of the state's public water systems get their drinking water from groundwater. Generally, the water quality of Oregon's aquifers is suitable for drinking and daily water needs. Statewide, the most serious threats to groundwater quality include leaking sewage treatment plants, agricultural runoff, industry, urbanization, and naturally occurring contaminants. (Oregon DEQ, 2015h)

Table 7.1.4-3 provides details on aquifer characteristics for Oregon's principal aquifers; Figure 7.1.4-3 shows Oregon's principal and sole source aquifers, discussed in greater detail below. Two other aquifers, Snake River Plain basin-fill and Snake River Plain basaltic-rock aquifers are situated in small portions of the eastern edge of the state, as shown in Figure 7.1.4-3. These two aquifers are more extensive in other states and represent a relatively small area within Oregon, and thus are not discussed in detail. For more information, see Idaho groundwater, Section, 5.1.4-7.

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, 2015b). Oregon has one designated SSA, North Florence Dunal SSA in the western part of the state (Figure 7.1.4-3). 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, 2015b).

⁵⁰ Igneous and metamorphic-rock aquifers are formed from lava flow and have variable permeability (how easily water or contaminants can flow through the aquifer/how tight the rocks are pressed together) in Idaho, Oregon and Washington. Basaltic rocks are the most productive aquifers in volcanic rocks. (USGS 2015f)

⁵¹ Sand and gravel aquifers of alluvial (sand, silt, or gravel materials left by river waters) and glacial origin are highly productive aquifers in the northern part of the country, consisting of mostly sand and gravel deposits formed by melting glaciers (USGS 2015g).

Table 7.1.4-3: Description of Oregon’s Principal Aquifers

Aquifer Type and Name	Location in State	Groundwater Quality
Basin and Range basin-fill aquifers Unconsolidated sand and gravel	Southeast corner of the state	Water is suitable for all uses. Principal water use is for public supply, domestic and commercial, irrigation and livestock watering and industry
Columbia Plateau basin-fill aquifers Unconsolidated deposits of coarse sand and gravel	North central part of the state around Hermiston and La Grande	Generally, water is suitable for most purposes. Water from this aquifer is of medium hardness due to a median dissolved-solids concentration. Contains median levels of nitrate concentrations. Uses provide for public-supply, domestic and commercial, and agricultural (primarily irrigation) purposes
Pacific Northwest basin-fill aquifers Unconsolidated sand and gravel	Western part of the state along the Pacific Ocean	Most productive aquifer in the region. Mostly contains freshwater but may yield saltwater, especially in south-central Oregon and in coastal areas. Provides freshwater for most public-supply, domestic, commercial, agricultural, irrigation and industrial purposes
Willamette Lowlands basin-fill aquifers Unconsolidated sand and gravel	Central northwest corner of the state stretching from Portland to Eugene	Water is suitable for most purposes. Water from this aquifer is of medium hardness due to a median dissolved-solids concentration. Contains some saline concentrations. Principal water use is for public supply, domestic and commercial, irrigation and livestock watering and industry
Columbia Plateau basaltic-rock aquifers Basaltic rocks (formed from lava flows)	North central to north eastern corner of the state	Water from this aquifer is generally suitable for most purposes. Water from this aquifer is of medium hardness due to a median dissolved-solids concentration. Contains high levels of nitrate concentrations. Water use provides for public-supply, domestic and commercial, agricultural (primarily irrigation), and industrial purposes
Pacific Northwest basaltic-rock aquifers Basaltic rocks (formed from lava flows)	Covers majority of the state, spreads throughout central to south eastern Oregon	Water is suitable for most uses though primarily used for agriculture. These aquifers generally yield freshwater but can yield saltwater as well. Most of the fresh groundwater withdrawals are used for irrigation purposes.

Sources: (Moody, Carr, Chase, & Paulson, 1986) (USGS, 1994b)

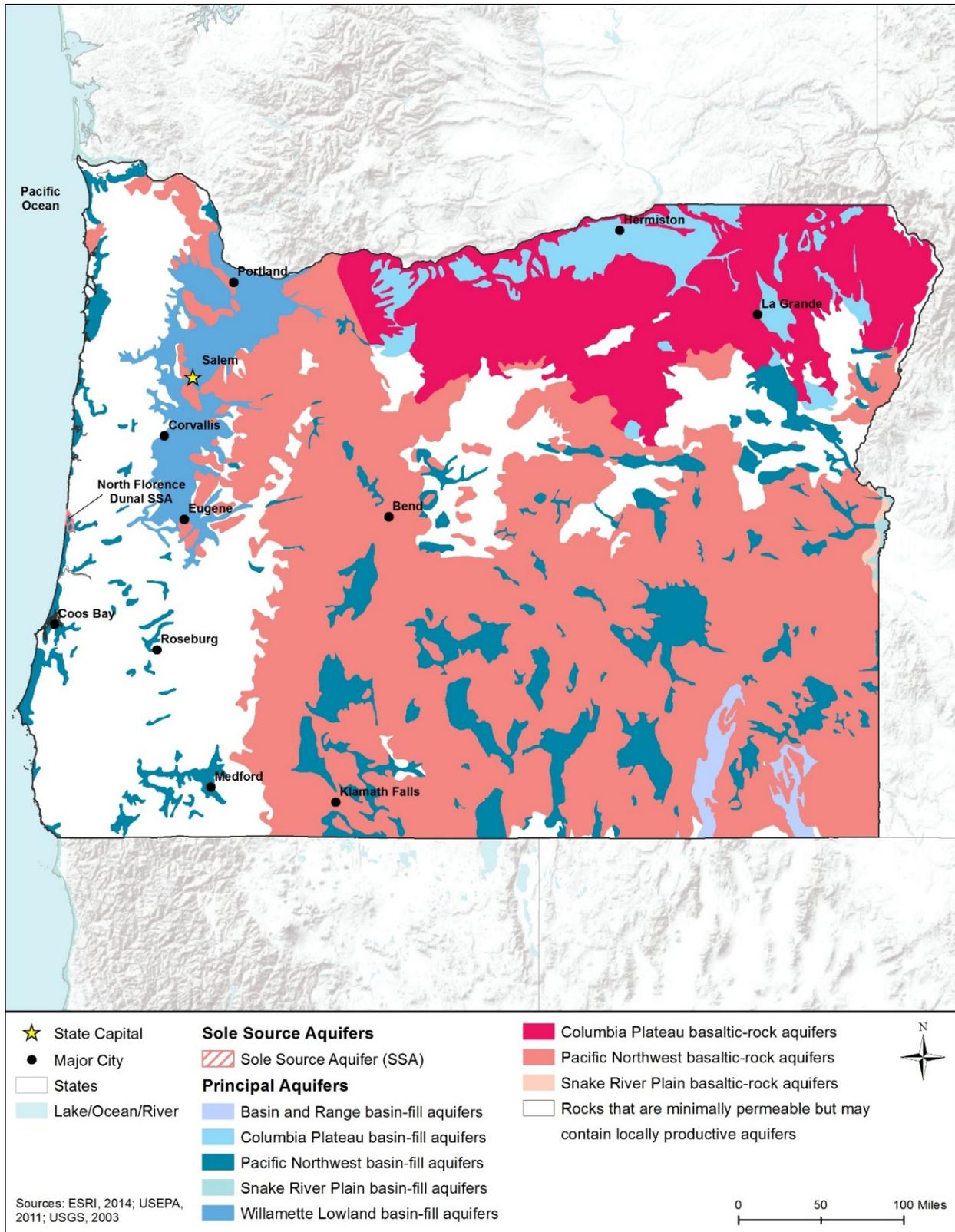


Figure 7.1.4-3: Principal and Sole Source Aquifers of Oregon

7.1.5. Wetlands

7.1.5.1. 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).

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)

7.1.5.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, describes the pertinent federal laws protecting wetlands in detail. Table 7.1.5-1 summarizes the major Oregon state laws and permitting requirements relevant to the state’s wetlands.

Table 7.1.5-1: Relevant Oregon Wetlands Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 404 permit, Oregon regional requirements	U.S. Army Corps of Engineers (USACE), Portland District	Except for NWPs 3, 20, 27, 32, 38, and 48, any activity that would result in a loss of waters of the U.S. in a high value aquatic resource ⁵² is not authorized by NWP. NWP 12, Utility Line Activities: Permittee shall install trench-blockers of a type and design sufficient to prevent the drainage of the wetland areas (e.g., bentonite clay plugs, compacted sand bags, etc.) where utility lines are buried within or immediately adjacent to wetlands and other waters. (USACE - Portland, 2015)
Oregon’s Removal-Fill Law	Oregon Division of State Lands (ODSL)	Individuals who remove or fill 50 cubic yards or more in “waters of the state” to obtain a permit from the DSL. In wetlands, most removal-fill activities require a permit, regardless of the number of cubic yards affected. (ODSL, 2015a)

⁵² High value aquatic resources in Oregon include bogs, fens, wetlands in dunal systems along the Oregon coast, native eel grass (*Zostera marina*) beds, kelp beds, rocky substrate in tidal waters, marine reserves, marine gardens, vernal pools, alkali wetlands, and Willamette Valley wet prairie wetlands. (USACE - Portland, 2015)

State Law/Regulation	Regulatory Agency	Applicability
Protection of Waters Program	Oregon Department of Environmental Quality (ODEQ)	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 ODEQ indicating that the proposed activity will not violate water quality standards. (Oregon DEQ, 2015e)

7.1.5.3. Environmental Setting: Wetland Types and Functions

The U.S. Fish and Wildlife Service’s (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard (WCS) that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined by (Cowardin L. M., Carter, Golet, & LaRoe, 1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 7.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a). Four of these systems—Palustrine, Riverine, Lacustrine, and Estuarine-Marine Intertidal are present in Oregon, as detailed in Table 7.1.5-2.

- “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. 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 or greater.”
- 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 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 L. M., Carter, Golet, & LaRoe, 1979)

In Oregon, the main type of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state as shown in Figure 7.1.5-1. Palustrine wetlands comprise approximately 92 percent of the wetlands in the state. Estuarine/marine (tidal) wetlands occur along the Pacific Ocean coastline, comprise approximately two percent of the total wetlands in

the state. Riverine and lacustrine wetlands, which occur throughout the state, comprise approximately four percent and two percent of the total wetlands in the state, respectively. (USFWS, 2014g)

Table 7.1.5-2 uses 2014 NWI data to characterize and map Oregon wetlands on a broad-scale.⁵³ The data are not intended for site-specific analyses and are 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. The map codes and colorings in Table 7.1.5-2 correspond to the wetland types in the figures.

Table 7.1.5-2: Oregon 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 is at least 20 feet tall. Floodplain forests and hardwood swamps are examples of PFO wetlands.	Forested lowlands within the state	276,904
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.	Throughout the state, often on stream floodplains	
Palustrine emergent wetlands	PEM	PEM wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens ⁵⁴ , prairie potholes, and sloughs.	On river and lake floodplains; more clustered in the south	1,046,769
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands are commonly known as freshwater ponds, and include all wetlands with at least 25% cover of particles smaller than stones and a vegetative cover less than 30%.	Throughout the state	38,802
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		

⁵³ 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.

⁵⁴ Fens are nutrient-rich, grass- and sedge-dominated emergent wetlands that are recharged from groundwater and have continuous running water. (Edinger, et al., 2014)

Wetland Type	Map Code and Color	Description ^a	Occurrence	Amount (acres) ^b
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep ⁵⁵ , and other miscellaneous wetlands are included in this group.	Abandoned fields, depressions (seeps), along hillsides and highways	28,096
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	55,628
Lacustrine wetland	L2	Lacustrine systems are lakes or shallow reservoir basins generally consisting of ponded waters in depressions or dammed river channels, with sparse or lacking persistent emergent vegetation, but including any areas with abundant submerged or floating-leaved aquatic vegetation. These wetlands are less than 8.2 feet deep.	Scattered throughout the state	27,519
Estuarine and Marine intertidal wetland	E2/M2	These intertidal wetlands include the areas between the highest tide level and the lowest tide level. Semidiurnal tides (two high tides and two low tides per day) periodically expose and flood the substrate. Wetland examples include vegetated and non-vegetated brackish (mix of fresh and saltwater), and saltwater marshes, shrubs, beaches, sandbars, or flats.	Along the coast of Oregon.	36,745
TOTAL				1,510,463

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

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

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

⁵⁵ 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).

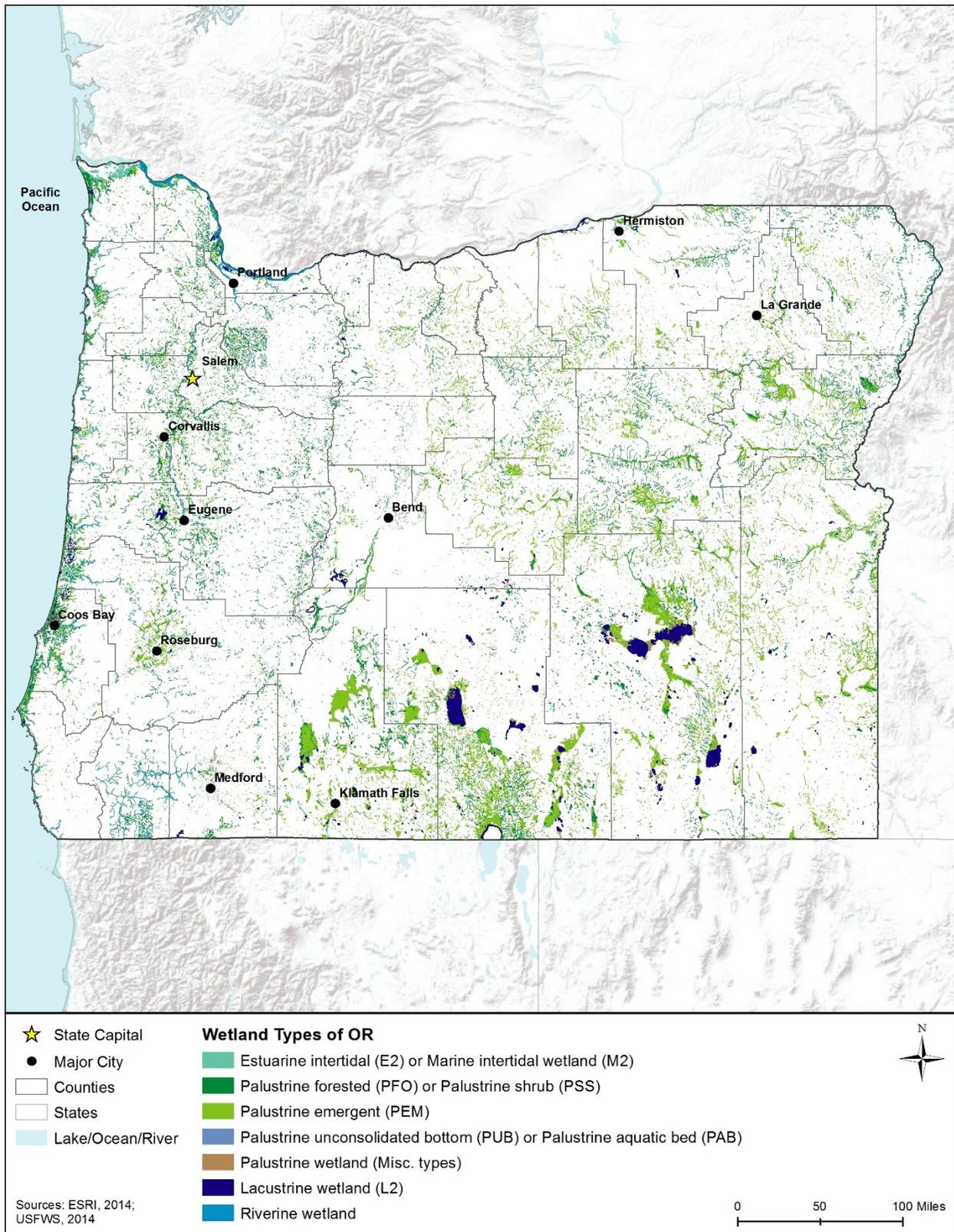


Figure 7.1.5-1: Wetlands by Type, in Oregon, 2014

Palustrine Wetlands

In Oregon, palustrine wetlands include the majority of vegetated freshwater wetlands (freshwater marshes, swamps, bogs, and ponds). Palustrine forested (PFO) wetlands include Oregon ash (*Fraxinus latifolia*), hardhack (*Spiraea douglasii*), Douglas and English hawthorn (*Crataegus douglasii* and *C. monogyna*), and rose (*Rosa spp.*). Palustrine scrub-shrub (PSS) wetlands vegetation shrub and forested wetlands in valleys support species such as red alder (*Alnus rubra*), willows (e.g., *Salix hookeriana*), water parsley (*Oenanthe sarmentosa*), skunk cabbage (*Lysichiton americanus*), salmonberry (*Rubus spectabilis*), and slough sedge (*Carex obnupta*). (ODSL, 2012) (Morlan, Blok, Miner, & Kirchner, 2010) (USACE, 2010).

Common palustrine emergent (PEM) wetlands in Oregon are dominated by the sedges and sedge-like species, such as, leafy tussock sedge (*Carex aquatilis*), Northwest Territory sedge (*C. utriculata*), Nebraska sedge (*C. nebrascensis*), common spikerush (*Eleocharis palustris*), and broad-leaf cattail (*Typha latifolia*). Temporarily flooded emergent vegetation is dominated by grasses and sedges including shrubs such as Labrador-tea (*Ledum glandulosum*), sweet gale (*Myrica gale*), and bog blueberry (*Vaccinium uliginosum*), and herbaceous plants including California pitcher plant (*Darlingtonia californica*) and tufted hairgrass (*Deschampsia cespitosa*); marshes and wet meadows (many diked or partially drained and used for pasture). PEM wetlands are the most common wetlands in the state. (ODSL, 2012) (Morlan, Blok, Miner, & Kirchner, 2010) (USACE, 2010)

Palustrine wetlands also include the shallow water zones of lakes, rivers, and ponds and aquatic beds (PAB/PUB) formed by water lilies and other floating-leaved or free-floating plants. Cattails (*Typha spp.*) are often found growing in or around PAB/PUB wetlands in Oregon, and they offer important breeding grounds for waterfowl and other wildlife. These are the easiest wetlands to recognize and occur throughout the state. Common emergent and floating vegetation includes species of cattail, rush (*Juncus spp.*), pondweed (*Potamogeton spp.*), yellow pond lily (*Nuphar lutea*), and watermilfoil (*Myriophyllum spp.*). (ODSL, 2012) (USACE, 2010)

Status of Palustrine Wetlands in Oregon

In the late 1700s, Oregon had an estimated 2.3 million acres of palustrine (freshwater) wetlands. Draining and filling for agriculture and urban development over the years have been the main threats to wetlands in the state, resulting in an almost 38 percent loss. (ODSL, 2012) In a 1997 study, palustrine wetlands were the most abundant type in the state (85 percent). Of the 85 percent, the palustrine wetlands are composed of PEM (50 percent), PFO/PSS (42 percent), PUB/PAB (6 percent), and other palustrine wetlands (2 percent) wetlands (ODSL, 2012). Based on the USFWS NWI 2014 analysis, ratios have changed, with PEM being the dominant wetland type (75 percent), followed by PFO/PSS (20 percent), PUB/PAB (ponds) (3 percent), and other palustrine wetlands (2 percent) (USFWS, 2014g). There are currently approximately 1.39 million acres of palustrine wetlands (USFWS, 2014g).

Lacustrine Wetlands

There are approximately 27,519 acres of lacustrine wetlands in the state, or 2 percent of the total wetlands (USFWS, 2014g). Typical plant species include pondweeds, watermilfoils, bladderworts (*Utricularia spp.*), and other submergent plants (ODSL, 2012).

Riverine Wetlands

These wetlands occur in broad valleys and have fine textured sediments that were deposited by springtime peak flows. There are approximately 55,628 acres of riverine wetlands in the state, or 4 percent of the total wetlands (USFWS, 2014g). Riverine wetlands are usually dominated by red alder (ODSL, 2012) (USACE, 2010).

Estuarine and Marine Wetlands

Estuarine wetlands have developed in the shallow, low-gradient reaches near the mouths of Oregon's coastal rivers and in their deltas. Estuarine/marine wetlands in the state include tide flats, eelgrass beds, and salt marshes. Tide flats (unconsolidated-shore wetlands) are mostly nonvegetated and exist where accumulations of sediment (sand, silt, clay, or gravel) are flooded and exposed daily by tides. Eelgrass-bed (aquatic-bed) wetlands are tide flats that have been extensively colonized by eelgrass (*Zostera spp.*), a plant that can tolerate high salinity. Salt marshes (emergent wetlands) are regularly to irregularly flooded emergent wetlands vegetated by salt-tolerant plants such as rushes, sedges, and woody saltwort (*Salicornia depressa*) (ODSL, 2012). There are approximately 36,745 acres of estuarine and marine wetlands in the state, or 2 percent of the total wetlands (USFWS, 2014g). Filling or excavation for transportation and commercial development are the main causes of estuarine wetland losses in Oregon. (ODSL, 2012) (USACE, 2010)

7.1.5.4. Wetlands of Special Concern or Value

In addition to protections under the CWA and the state's regulatory framework, Oregon considers certain wetland communities as areas of special value or high quality due to their global or regional scarcity, "unusual local importance," or habitat they support. These include those wetlands that are considered a "high value aquatic resource, as protected by the USACE." These consist of the following types of wetlands: bogs, fens, wetlands in dunal systems along the Oregon coast, vernal pools, alkali wetlands, and Willamette Valley wet prairie wetlands. (USACE - Portland, 2015)

"Extensive agricultural and urban development has greatly affected the extent and quality of Oregon's wetlands" (ODSL, 2012). Losses for wetlands of concern have been high; such as 99.5 percent of wet prairie and 98 percent of peatland in the Willamette Valley, 88 percent of tidal spruce swamps along the coast and lower Columbia River, and 40 percent of Agate Desert vernal pools in southwestern Oregon (ODSL, 2012).

Bogs and Fens

In Oregon, areas classified as a bog or fen are protected under the USACE Nationwide permit due to the scarcity of this habitat in the state and the difficulty with in-kind mitigation. Both

habitats contain a “sponge-like organic soil layer and often have extensive cover of sedges and/or broad-leaved evergreen shrubs (e.g., *Ledum*)” (Oregon Rapid Wetland Assessment Protocol, 2009). Bogs are acidic wetlands that form thick organic (peat) deposits up to 50 feet deep or more. They have little groundwater influence and are recharged through precipitation. The standing, nutrient-poor, acidic water slows all processes in a bog, including nutrient recycling, making bogs very sensitive to external disturbance. Fens are nutrient-rich, grass- and sedge⁵⁶-dominated emergent wetlands that are recharged from groundwater and have continuous running water. This wet meadow habitat supports distinctive plant communities, including many species that are only found in Oregon. (ODSL, 2011b) (Morlan, Blok, Miner, & Kirchner, 2010)

Vernal Pools

Vernal pools are a type of small, depressional, temporary wetland. The pools occur in shallow depressions that fill from spring or fall precipitation, and are usually dry by late summer or during droughts since they are not connected to a permanent water source. Vernal pools fill from rain, snowmelt, or groundwater. These small wetlands contribute to storage and filtration of surface water and help recharge aquifers. Each vernal pool has distinctive native plant species based on its location within the state. (USEPA, 2015c)

In the Willamette Valley, vernal pools have a clay bottom. Common plants include elegant calico flower (*Downingia elegans*), Nuttall’s quillwort (*Isoetes nuttallii*), fool’s onion (*Triteleia hyacinthina*), spike rush (*Eleocharis spp.*), coyote thistle (*Eryngium petiolatum*), fragrant popcorn flower (*Plagiobothrys figuratus*), meadow popcorn flower (*P. scouleri*), Idaho gumweed (*Grindelia nana*), neckweed (*Veronica peregrina*), smooth lasthenia (*Lasthenia glaberrima*), Oregon timwort (*Cicendia quadrangularis*), sharp-leaf cancerwort (*Kickxia elatine*), western marsh cudweed (*Gnaphalium palustre*), and water starwort (*Callitriche spp.*). (ODSL, 2011b) (USACE, 2014)

In the Medford area, vernal pools are acidic and have concentric rings of similar native vegetation, including Cascade calico flower (*D. yina*), Nuttall’s quillwort, American pillwort (*Pilularia Americana*), fool’s onion, spike rush, coyote thistle, bracted popcorn flower (*Plagiobothrys brachteatus*), meadow popcorn flower, Idaho gumweed, neckweed, pacific meadow-foxtail (*Alopecurus saccatus*), California goldfields (*Lasthenia californica*), annual hairgrass (*Deschampsia danthonioides*), and water starwort. (ODSL, 2011b) (Agate Desert Technical Advisory Committee, 2007) (USACE, 2014)

Vernal pools in the Modoc basalt and Columbia Plateau are on shallow basalt bedrock and often having the following plant species small camas (*Camassia quamash*), dense-flower willowherb (*Epilobium densiflorum*), winged water starwort (*Callitriche marginata*), Oregon timwort, dwarf woolyheads (*Psilocarphus brevissimus*), and Sierra mock stonecrop (*Sedella pumila*). (ODSL, 2011b) (USACE, 2014)

⁵⁶ Sedge: an herbaceous plant with triangular cross-sectional stems and spirally arranged leaves (grasses have alternative leaves) typically associated with wetlands or poor soils.

Interdunal wetlands

Interdunal wetlands are temporary wetlands occurring in depressions in dunes, often between sand dunes where wind has scoured the sand down to the water table (where the groundwater reaches the surface). In Oregon, these types of wetlands are found along the coastline. Common plant species include slough sedge (*Carex obnupta*), common silverweed (*Argentina egedii*), salt rush (*Juncus lesueurii*), Sierran rush (*J. nevadensis*), sickle-leaf rush (*J. falcatus*), golden blue-eyed grass (*Sisyrinchium californicum*) and coastal willow (*Salix hookeriana*). (ODSL, 2011b) (USACE, 2014)

Alkali Wetlands

Alkali wetlands are nontidal depressional wetlands with saline (salty) or alkaline (acidic) conditions fluctuating water levels. Vegetation is usually sparse or consists of species that are able to live in the saline or alkaline conditions. Example species include coastal salt grass (*Distichlis spicata*), boraxweed (*Nitrophila occidentalis*), and salt meadow cordgrass (*Spartina patens*). For additional plant species typically occurring in alkali wetlands, see the *Salt Tolerant and Low Tidal Marsh Plants* information sheet at (www.oregonstatelands.us/DSL/WETLAND/docs/orwap-suppinfo-p_salt-p_lowtidal.pdf). (ODSL, 2011b) (USACE, 2014)

Willamette Valley Wet Prairie Wetlands

Willamette Valley wet prairie wetlands are seasonal depressional wetlands with common species shown in Figure 7.1.5-2 including tufted hairgrass, American slough grass (*Bechmannia syzigachne*), cobraplant (*Danthonia californica*), small camas, dense sedge (*Carex densa*), and one-sided sedge (*C. unilateralis*) (Morlan, Blok, Miner, & Kirchner, 2010) (ODSL, 2011b).



Source: (Morlan, Blok, Miner, & Kirchner, 2010)

Figure 7.1.5-2: Common Plant Species in Willamette Valley Wet Meadow Wetland

7.1.6. Biological Resources

7.1.6.1. Definition of the Resource

This chapter describes the biological resources for the state of Oregon. Biological resources include terrestrial⁵⁷ vegetation, wildlife, fisheries and aquatic⁵⁸ habitats, and threatened⁵⁹ and endangered⁶⁰ species, and communities and species of concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Because of the topographic variation within the state, and its location along the Pacific coast, Oregon supports biological resources ranging from marine⁶¹ and estuarine habitat⁶² settings along the coast to the west, deciduous⁶³ and coniferous⁶⁴ forests scattered between the coastal regions and central regions of the state, and desert settings in the south and east. Each of these topics is discussed in more detail below.

7.1.6.2. Specific Regulatory Considerations

The federal laws relevant to the protection and management of biological resources in Oregon are summarized in Appendix C, Environmental Laws and Regulations and Section 1.8, Overview of Relevant Federal Laws and Executive Orders. Table 7.1.6-1 summarizes the major state laws relevant to the Oregon’s biological resources.

Table 7.1.6-1: Relevant Oregon Biological Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oregon’s Removal-Fill Law (ORS 196.795-990)	Oregon Division of State Lands (ODSL)	Requires permit approval for any removal or fill in a water (or wetland) of the state. This includes non-navigable and isolated waters.
Oregon Statewide Planning Goals & Guidelines (OAR 660-015-0000)	Oregon Department of Land Conservation and Development Commission and local agencies.	Oregon statewide planning goals were established to ensure local governments comprehensive planning included state initiatives and laws. Goals have been established for citizen involvement, land use planning, agricultural lands, forest lands, natural resources, air, water, and land resource quality, natural hazard areas, recreational needs, economic development and housing, public facilities, transportation, energy conservation, urbanization, Willamette River greenway, estuarine resources, coastal shorelands, beaches and dunes, and ocean resources.

⁵⁷ Terrestrial: “Pertaining to the land” (USEPA, 2015s).

⁵⁸ Aquatic: “Pertaining to water” (USEPA, 2015s).

⁵⁹ 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))

⁶⁰ 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))

⁶¹ Marine: “Any marine environment, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment.” (USEPA, 2015s)

⁶² Estuarine habitat: “An estuary is the area where a river or stream connects to the open sea or ocean, estuarine includes the estuary and its associated habitats such as seagrasses and shellfish beds.” (USEPA, 2015s)

⁶³ Deciduous: “Trees such as oaks and maples that lose their leaves during part of the year.” (USEPA, 2015s)

⁶⁴ Coniferous: “Cone-bearing trees, mostly evergreens that have needle-shaped or scale-like leaves. They produce wood known commercially as softwood.” (USEPA, 2015s)

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 401 Removal/Fill Certification	ODEQ	Section 401 of the CWA authorizes DEQ to ensure that activities will meet water quality standards established by the state under the CWA. By ensuring a project does not degrade water quality, Oregon’s waters remain safe for a wide range of uses, such as drinking water, recreation, fish habitat, aquatic life, and irrigation.
NPDES	ODEQ	Construction stormwater general permit requires controls in place to control off site water particularly in areas where receiving waters are considered sensitive resources (i.e., waters of the state).
Local Laws for Tree Removal	Local Counties and Cities	Most local jurisdictions in Oregon require a permit to remove trees of a certain type and/or size. Regulations vary depending on jurisdiction.
Oregon Noxious Weed Quarantine (OAR 603-052-1200)	Oregon Department of Agriculture.	State noxious weed quarantines prohibit the import, transport, propagation, or sale of a subset of weeds listed on both state and federal noxious weed lists.

7.1.6.3. Terrestrial Vegetation

The distribution of flora within Oregon is a function of the characteristic geology,⁶⁵ soils, climate,⁶⁶ and water of a given geographic area and correlates to distinct areas identified as ecoregions.⁶⁷ Ecoregions are broadly defined areas that share similar characteristics, such as climate, geology, soils, and other environmental conditions and represent ecosystems contained within a region. The boundaries of an ecoregion are not fixed, but rather depict a general area with similar ecosystem types, functions, and qualities. (National Wildlife Federation, 2015); (USDA, 2015a); (World Wildlife Fund, 2015)

Ecoregion boundaries often coincide with physiographic⁶⁸ regions of a state. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also defined 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 Oregon at USEPA Level III ecoregion. (USEPA, 2016a)

⁶⁵ USGS defines geology as an interdisciplinary science with a focus on the following aspects of earth sciences: geologic hazards and disasters, climate variability and change, energy and mineral resources, ecosystem and human health, and ground-water availability.

⁶⁶ 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, 2015s)

⁶⁷ Ecoregion: “A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables.” (USEPA, 2015s)

⁶⁸ Physiographic: “The natural, physical form of the landscape.” (USEPA, 2015s)

As shown in Figure 7.1.6-1, the USEPA divides Oregon into nine Level III ecoregions: Coast Range, Willamette Valley, Cascades, Eastern Cascades Slopes and Foothills, Columbia Plateau, Blue Mountains, Snake River Plain, Klamath Mountains, and Northern Basin and Range.

These ecoregions support a variety of different plant communities; all predicated on their general location within the state. Within each ecoregion, a variety of habitat types can be found. These habitat types are not only dependent on location within the state but are also largely dependent on elevation, soils, and water availability/influence. For example in the Coast Range, habitat types include sand dunes and grasses, old growth forests, coastal forests, cranberry bogs, estuaries, riparian areas, and wetlands. Figure 7.1.6-1 provides a summary of the general abiotic⁶⁹ characteristics, vegetative communities, and the typical vegetation found within each of the nine Oregon ecoregions.

⁶⁹ 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, 2015s)

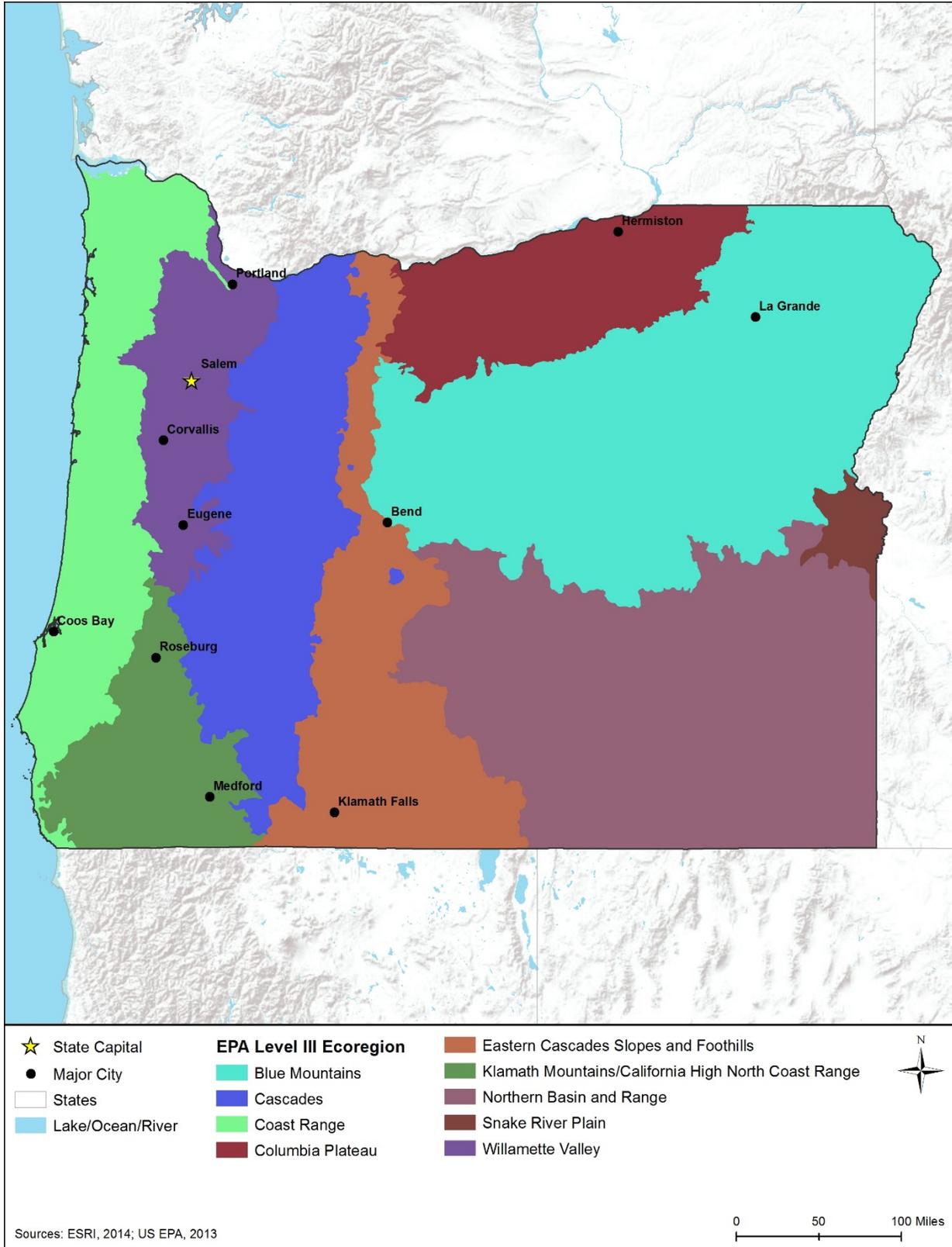


Figure 7.1.6-1: USEPA Level III Ecoregions in Oregon

Table 7.1.6-2: USEPA Level III Ecoregions of Oregon

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
Geographic Region: Coast				
1	Coast Range	Coastal lowlands consist of low gradient streams, tidal marshes, and floats. Coastal uplands consists of steeper gradients with medium and large streams.	Redwood forests, Douglas-fir/western hemlock forests, sand dunes, tidal flats, marshes.	<ul style="list-style-type: none"> • Hardwoods – red alders (<i>Alnus rubra</i>), Oregon ash (<i>Fraxinus latifolia</i>) • Conifer Trees – shore pine (<i>Pinus contorta</i>), Sitka (<i>Picea sitchensis</i>), western hemlock (<i>Tsuga heterophylla</i>), western red-cedar (<i>Thuja plicata</i>), Douglas-fir (<i>Pseudotsuga menziesii</i>) • Shrubs – salal (<i>Gaultheria shallon</i>), evergreen huckleberry (<i>Vaccinium ovatum</i>), salmonberry (<i>Rubus spectabilis</i>)
Geographic Region: Willamette Valley				
3	Willamette Valley	The majority of this ecoregion has been altered by development; however, oak woodlands, grasslands, wetland, riparian areas, and aquatic habitats can all be found in fragmented habitats.	Fragmented habitats including grasslands, oak woodlands, riparian, and wetlands located on mountain foothills and floodplains.	<ul style="list-style-type: none"> • Hardwoods – Oregon white oak (<i>Quercus garryana</i>), red alder (<i>Alnus rubra</i>), Oregon ash (<i>Fraxinus latifolia</i>), bigleaf maple (<i>Acer macrophyllum</i>) • Conifer Trees – Douglas-fir (<i>Pseudotsuga menziesii</i>), western red-cedar (<i>Thuja plicata</i>), western hemlock (<i>Tsuga heterophylla</i>) • Shrubs – Willow species, Douglas spiraea (<i>Spiraea douglasii</i>), and snowberry (<i>Symphoricarpos</i>). Invasives including Himalayan black-berry (<i>Rubus armeniacus</i>) and Reed canarygrass (<i>Phalaris arundinacea</i>) dominate in areas without trees
Geographic Region: The Cascades				
4	Cascades	Characterized by steep slopes with cool wet winters and warm dry summers. Fourteen volcanoes can be found within this ecoregion, which largely influence soil development and habitat.	Douglas-fir/western hemlock forests, silver fir/red fir forests.	<ul style="list-style-type: none"> • Hardwoods – red alder (<i>Alnus rubra</i>), cottonwoods, bigleaf maple (<i>Acer macrophyllum</i>) • Conifer Trees – Douglas-fir (<i>Pseudotsuga menziesii</i>), western hemlock (<i>Tsuga heterophylla</i>), true firs (<i>Abies sp.</i>) • Shrubs – vine maple (<i>Acer circinatum</i>), red osier dogwood (<i>Cornus sericea</i>), salmonberry (<i>Rubus spectabilis</i>), stink current (<i>Ribes bracteosum</i>)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
Geographic Region: East of the Cascades				
9	Eastern Cascades Slopes and Foothills	Varies greatly from cool and moist along the cascade border to dry and warm towards the east. Forested uplands, marshes, and agricultural fields characterize this ecoregion.	Mixed conifer, ponderosa pine, western juniper, grand fir, grasslands, and shrubland steppe.	<ul style="list-style-type: none"> • Hardwoods – Mountain alders, water birch (<i>Betula occidentalis</i>) • Conifer Trees – Grand fir (<i>Abies grandis</i>), white fir (<i>Abies concolor</i>), ponderosa pine (<i>Pinus ponderosa</i>), western-red cedar (<i>Thuja plicata</i>), lodgepole pine (<i>Pinus contorta</i>) • Shrubs – vine maple (<i>Acer circinatum</i>), Douglas’ spiraea (<i>Spiraea douglasii</i>), red osier dogwood (<i>Cornus sericea</i>), snowberry (<i>Symphoricarpos</i>)
10	Columbia Plateau	Undulating hills and plateaus dissected by steep-sided canyons.	Ponderosa pine, western juniper, shrub steppe, grasslands.	<ul style="list-style-type: none"> • Hardwoods – Water birch (<i>Betula papyrifera</i>), mountain alders, hawthorn (<i>Crataegus</i>), black cottonwood (<i>Populus trichocarpa</i>) • Conifer Trees – lodgepole pine (<i>Pinus contorta</i>), western juniper (<i>Juniperus occidentalis</i>), ponderosa pine (<i>Western yellow pine</i>) • Shrubs – Douglas’ spirea (<i>Spiraea douglasii</i>), red osier dogwood (<i>Cornus sericea</i>), willows, snowberry (<i>Symphoricarpos</i>), big sagebrush (<i>Artemisia tridentata</i>)
11	Blue Mountains	Consists of a diverse complex of mountain ranges, valleys, steep river canyons, and plateaus, with habitats ranging from dry sagebrush steppe to high alpine peaks.	Habitats range from dry sagebrush steppe to high alpine peaks.	<ul style="list-style-type: none"> • Hardwoods – Cottonwoods, white alder (<i>Alnus rhombifolia</i>) • Conifer Trees – junipers, Engelmann spruce (<i>Picea engelmannii</i>), Douglas fir (<i>Pseudotsuga menziesii</i>), lodgepole pine (<i>Pinus contorta</i>), white fir (<i>Abies concolor</i>), ponderosa pine (<i>Pinus ponderosa</i>) and true firs. • Shrubs – Pacific ninebark (<i>Physocarpus capitatus</i>), willows, red-osier dogwood (<i>Cornus sericea</i>), snowberry (<i>Symphoricarpos</i>)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
12	Snake River Plain	Many alluvial valleys bordering the Snake River. This ecoregion is at a considerably lower elevation with more gradual slope contours than surrounding ecoregions with agriculture, cattle feedlots, and sagebrush steppe.	Sagebrush steppe.	<ul style="list-style-type: none"> • Hardwoods – Cottonwoods, aspens, mountain alders, hawthorn (<i>Crataegus</i>), chokecherry (<i>Prunus virginiana</i>) • Conifer Trees – Ponderosa pine (<i>Pinus ponderosa</i>), Douglas-fir (<i>Pseudotsuga menziesii</i>) • Shrubs – Sagebrushes, bitterbrush (<i>Purshia tridentata</i>)
80	Northern Basin and Range	Occurs in the rain shadow of the Cascade Mountains and is the driest ecoregion in Oregon.	Aspen woodlands, big sagebrush, and, shrublands.	<ul style="list-style-type: none"> • Hardwoods – Cottonwoods, aspens, mountain alders, hawthorn (<i>Crataegus</i>), chokecherry (<i>Prunus virginiana</i>) • Conifer Trees – Junipers, ponderosa pine (<i>Pinus ponderosa</i>) • Shrubs – Sagebrushes, bitterbrush (<i>Purshia tridentata</i>)
Geographic Region: Klamath				
78	Klamath Mountains/ California High North Coast Range	Consists of a wide range in elevation, topography, and climate.	Forest habitats, grasslands, and aquatic habitats.	<ul style="list-style-type: none"> • Hardwoods – Oregon white oak (<i>Quercus garryana</i>), California black oak (<i>Quercus kelloggii</i>), madrone (<i>Arbutus menziesii</i>), tanoak (<i>Notholithocarpus densiflorus</i>), Port Orford cedar (<i>Chamaecyparis lawsoniana</i>) • Conifer Trees – Douglas-fir (<i>Pseudotsuga menziesii</i>), incense cedar (<i>Calocedrus decurrens</i>), ponderosa pine (<i>Pinus ponderosa</i>), Jeffery pine (<i>Pinus jeffreyi</i>) • Shrubs – salal (<i>Gaultheria shallon</i>), evergreen huckleberry (<i>Vaccinium ovatum</i>), salmonberry (<i>Rubus spectabilis</i>)

Sources: (Thorson, et al., 2003) (Elias, 1989) (Petrides, 1973) (USEPA, 2013a) (USEPA, 2011b) (CEC, 2011)

Communities of Concern

Oregon contains several vegetative communities of concern that include rare natural plant communities, plant communities with vulnerability or sensitivity to disturbance, and communities that provide habitat for both rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances generated by the Proposed Action. This ranking system also provides an indication as to the level of potential impact a particular community could experience from an action.

The Oregon Biodiversity Information Center (ORBIC) (formally named the Oregon Natural Heritage Information Center) manages a statewide inventory that includes lists of all types of natural communities known to occur, or that have historically occurred, in the state. The historical occurrences are important for assessing previously undocumented occurrences or re-occurrences of previously documented species. Each natural community is assigned a priority rank based on its risk that the plant community may disappear. Priority Ranks include High, Medium, and Low. The priority ranking is determined by its NatureServe⁷⁰/Natural Heritage rank. High priority includes those ranked as G1, G2 or S1, moderate priority includes those ranked G3, S2, or G4S3, and low priority is ranked lower than those above. (ORBIC, 2010)

There are 28 larger vegetative communities found across the nine ecoregions that contain sub communities that are ranked as high priority. One hundred twenty sub-communities are ranked as high priority in Oregon, meaning that they contain either a G1, G2, or S1 ranking. (ORBIC, 2010)

Oregon also participates in the USFWS required Wildlife Conservation Strategy planning and has completed several conservation strategy publications. In addition, the Oregon Department of Fish and Wildlife (ODFW) have prepared an action plan also known as the Oregon Conservation Strategy. The action plan provides an adaptive and comprehensive framework for continued positive action and new innovation (ODFW, 2015b).

Nuisance and Invasive Plants

There are a large number of undesirable plant species that are considered nuisance and invasive plants. Direct impacts to nuisance and invasive plants may be viewed as beneficial to the environment, but such impacts often result in the inadvertent and unintended spread and dispersal of these species. Construction sites in particular provide colonizing opportunities for nuisance and invasive species, and long-term maintenance activities can perpetuate a disturbance regime that facilitates a continued dispersal mechanism for the spread of these species. Noxious weeds⁷¹ are typically non-native species that have been introduced into an ecosystem

⁷⁰ NatureServe is a non-profit organization that provides high-quality scientific expertise for conservation projects with over 1,000 conservation professionals from the United States, Canada, and Latin America (www.natureserve.org).

⁷¹ Noxious weeds: “any living stage (e.g., seeds and reproductive parts) of any parasitic or other plant of a kind, or subdivision of a kind, which is of foreign origin, is new to or not widely prevalent in the U.S., and can directly or indirectly injure crops, other useful plants, livestock, or poultry or other interests of agriculture, including irrigation, or navigation or the fish and wildlife resources of the U.S. or the public health.” (Federal Noxious Weed Act of 1974)

inadvertently; however, some native species are also considered noxious. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (U.S. GPO, 2012). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S. Code [U.S.C.] 7701 *et seq.*). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the United States (88 terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015c).

The Oregon Department of Agriculture (ODA) Noxious Weed Control Program provides statewide coordination and management of state listed noxious weeds designated under ORS 569.615 (ODA, 2015a). Although there is no policy related to the prohibition of noxious weeds in Oregon, there are policies in place to prevent the establishment and spread of listed noxious weeds. Table 7.1.6-3 lists designated weeds in Oregon.

Table 7.1.6-3: Designated Weeds in Oregon

Common Name	Scientific Name
African rue	<i>Peganum harmala</i>
Cape-ivy	<i>Delairea odorata</i>
Camelthorn	<i>Alhagi pseudalhagi</i>
Coltsfoot	<i>Tussilago farfara</i>
Common cordgrass	<i>Spartina anglica</i>
Dense-flowered cordgrass	<i>Spartina densiflora</i>
Saltmeadow cordgrass	<i>Spartina patens</i>
Smooth cordgrass	<i>Spartina alterniflora</i>
Common frogbit	<i>Hydrocharis morsus-ranae</i>
European water chestnut	<i>Trapa natans</i>
Flowering rush	<i>Butomus umbellatus</i>
Giant hogweed	<i>Heracleum mantegazzianum</i>
Barbed goatgrass	<i>Aegilops triuncialis</i>
Ovate goatgrass	<i>Aegilops ovata</i>
Goatsrue	<i>Galega officinalis</i>
King-devil hawkweed	<i>Pilosella piloselloides (Hieracium)</i>
Mouse-ear hawkweed	<i>Pilosella (Hieracium)</i>
Orange hawkweed	<i>Pilosella aurantiacum (Hieracium)</i>
Yellow hawkweed	<i>Pilosella floribundum (Hieracium)</i>
Hoary alyssum	<i>Berteroa incana</i>
Hydrilla	<i>Hydrilla verticillata</i>
Japanese dodder	<i>Cuscuta japonica</i>
Kudzu	<i>Pueraria lobate</i>

Common Name	Scientific Name
Matgrass	<i>Nardus stricta</i>
Oblong spurge	<i>Euphorbia oblongata</i>
Paterson's curse	<i>Echium plantagineum</i>
Purple nutsedge	<i>Cyperus rotundus</i>
Ravennagrass	<i>Saccharum ravennae</i>
Silverleaf nightshade	<i>Solanum elaeagnifolium</i>
West Indian spongeplant	<i>Limnobium laevigatum</i>
Squarrose knapweed	<i>Centaurea virgate</i>
Iberian starthistle	<i>Centaurea iberica</i>
Purple starthistle	<i>Centaurea calcitrapa</i>
Syrian bean-caper	<i>Zygophyllum fabago</i>
Plumeless thistle	<i>Carduus acanthoides</i>
Smooth distaff thistle	<i>Carthamus baeticus</i>
Taurian thistle	<i>Onopordum tauricum</i>
Woolly distaff thistle	<i>Carthamus lanatus</i>
Water soldiers	<i>Stratiotes aloides</i>
White bryonia	<i>Bryonia alba</i>
Yellow floating heart	<i>Nymphoides peltata</i>
Yellowtuft	<i>Alyssum murale, A. coriscum</i>
Armenian (Himalayan) blackberry	<i>Rubus armeniacus (R. procerus, R. discolor)</i>
Biddy-biddy	<i>Acaena novae-zelandiae</i>
French broom	<i>Genista monspessulana</i>
Scotch broom	<i>Cytisus scoparius</i>
Spanish broom	<i>Spartium junceum</i>
Portuguese broom	<i>Cytisus striatus</i>
Buffalobur	<i>Solanum rostratum</i>
Butterfly bush	<i>Buddleja davidii (B. variabilis)</i>
Common bugloss	<i>Anchusa officinalis</i>
Common crupina	<i>Crupina vulgaris</i>
Common reed	<i>Phragmites australis</i>
Creeping yellow cress	<i>Rorippa sylvestris</i>
Cutleaf teasel	<i>Dipsacus laciniatus</i>
Dodder	<i>Cuscuta spp.</i>
Dyer's woad	<i>Isatis tinctoria</i>
Atlantic ivy	<i>Hedera hibernica</i>

Common Name	Scientific Name
English ivy	<i>Hedera helix</i>
Eurasian watermilfoil	<i>Myriophyllum spicatum</i>
False brome	<i>Brachypodium sylvaticum</i>
Field bindweed	<i>Convolvulus arvensis</i>
Garlic mustard	<i>Alliaria petioloata</i>
Herb Robert geranium	<i>Geranium robertianum</i>
Shiny leaf geranium	<i>Geranium lucidum</i>
Gorse	<i>Ulex europaeus</i>
Halogeton	<i>Halogeton glomeratus</i>
Houndstongue	<i>Cynoglossum officinale</i>
Indigo bush	<i>Amorpha fruticosa</i>
Johnsongrass	<i>Sorghum halpense</i>
Jointed goatgrass	<i>Aegilops cylindrical</i>
Jubata grass	<i>Cortaderia jubata</i>
Diffuse knapweed	<i>Centaurea diffusa</i>
Meadow knapweed	<i>Centaurea pratensis</i>
Russian knapweed	<i>Acroptilon repens</i>
Spotted knapweed	<i>Centaurea stoebe (C. maculosa)</i>
Giant knotweed	<i>Fallopia sachalinensis (Polygonum)</i>
Himalayan knotweed	<i>Polygonum polystachyum</i>
Japanese knotweed	<i>Fallopia japonica (Polygonum)</i>
Kochia	<i>Kochia scoparia</i>
Lesser celandine	<i>Ranunculus ficaria</i>
Meadow hawkweed	<i>Pilosella caespitosum (Hieracium)</i>
Mediterranean sage	<i>Salvia aethiopis</i>
Medusahead rye	<i>Taeniatherum caput-medusae</i>
Old man's beard	<i>Clematis vitalba</i>
Parrot feather	<i>Myriophyllum aquaticum</i>
Perennial peavine	<i>Lathyrus latifolius</i>
Perennial pepperweed	<i>Lepidium latifolium</i>
Pheasant's eye	<i>Adonis aestivalis</i>
Poison hemlock	<i>Conium maculatum</i>
Policeman's helmet	<i>Impatiens glandulifera</i>
Puncturevine	<i>Tribulus terrestris</i>
Purple loosestrife	<i>Lythrum salicaria</i>

Common Name	Scientific Name
Ragweed	<i>Ambrosia artemisiifolia</i>
Ribongrass	<i>Phalaris arundinacea var. Picta</i>
Rush skeletonweed	<i>Chondrilla juncea</i>
Saltcedar	<i>Tamarix ramosissima</i>
Small broomrape	<i>Orbanche minor</i>
South American waterweed	<i>Egeria densa (Elodea)</i>
Spanish heath	<i>Erica lusitanica</i>
Spikeweed	<i>Hemizonia pungens</i>
Spiny cocklebur	<i>Xanthium spinosum</i>
Spurge laurel	<i>Daphne laureola</i>
Leafy spurge	<i>Euphorbia esula</i>
Myrtle spurge	<i>Euphorbia myrsinites</i>
St. Johnswort	<i>Hypericum perforatum</i>
Sulfur cinquefoil	<i>Potentilla recta</i>
Swainsonpea	<i>Sphaerophysa salsula</i>
Tansy ragwort	<i>Senecio jacobaea</i>
Bull thistle	<i>Cirsium vulgare</i>
Canada thistle	<i>Cirsium arvense</i>
Italian thistle	<i>Carduus pycnocephalus</i>
Milk thistle	<i>Silybum marianum</i>
Musk thistle	<i>Carduus nutans</i>
Scotch thistle	<i>Onopordum acanthium</i>
Slender-flowered thistle	<i>Carduus tenuiflorus</i>
Dalmatian toadflax	<i>Linaria dalmatica</i>
Yellow toadflax	<i>Linaria vulgaris</i>
Tree of heaven	<i>Ailanthus altissima</i>
Velvetleaf	<i>Abutilon theophrasti</i>
Large-flower primrose-willow	<i>Ludwigia grandiflora</i>
Floating willow	<i>Ludwigia hexapetala</i>
Water primrose	<i>Ludwigia peploides</i>
Hairy whitetop	<i>Lepidium pubescens</i>
Lens-podded whitetop	<i>Lepidium chalepensis</i>
Whitetop (hoary cress)	<i>Lepidium draba</i>
Yellow archangel	<i>Lamiastrum galeobdolon</i>
Yellow flag iris	<i>Iris pseudacorus</i>

Common Name	Scientific Name
Yellow nutsedge	<i>Cyperus esculentus</i>
Yellow starthistle	<i>Centaurea solstitialis</i>

7.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Oregon, divided among mammals, birds, reptiles and amphibians, and invertebrates. Terrestrial wildlife are those species of animals, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals and furbearers⁷², nongame animals, and game birds, waterfowl, and their habitats found in Oregon. A discussion of non-native or invasive wildlife species is also included. Oregon’s landscape and climate is diverse across the state and offers a wide range of habitat to support both terrestrial and aquatic species. More than 700 wildlife species occur in Oregon (O’Neil & Johnson, 2001).

Mammals⁷³

Common mammals found in Oregon include bats, bears, beavers, cats, coyotes, wolves, foxes, gophers, nutria, hoofed mammals, mountain beavers, pikas, rabbits, hares, porcupines, pocket mice, kangaroo rats, kangaroo mice, other rats and mice, ringtails, raccoons, opossums, shrews, moles, squirrels, chipmunks, marmots, weasels, skunks, badgers, otters, seals, sea lions, whales, dolphins, and porpoises (ODFW, 2016a). Threatened or endangered mammal species are discussed in Section 7.1.6.6.

Invasive Mammal Species

ODFW monitors and works to control the spread of invasive wildlife species in Oregon. Although several wildlife species are considered invasive (such as the opossum), the feral swine (*Sus scrofa*) is the only wildlife species actively controlled by the state.

Birds

Due to the variety of ecological communities (i.e., coastal, valley, desert, forest, mountains, rivers, lakes, etc.) several species of native birds, introduced species, accidentals,⁷⁴ and birds that are currently expanding their ranges can be found in Oregon. Oregon ranks fifth in the nation for species richness boasting an estimated 486 bird species (National Audubon Society, 2015). Bird species of Oregon include swans, ducks, geese, pheasants, grouse, quail, turkey, loons, grebes, pelicans, cormorants, bitterns, herons, egrets, raptors, rails, coots, cranes, shorebirds, gulls, terns, murrets, auklets, puffins, doves, pigeons, owls, nighthawks, swifts, hummingbirds, kingfishers, woodpeckers, flycatchers, larks, vireos, shrikes, crows, jays, magpies, larks, swallows, martins, chickadees, nuthatches, wrens, kinglets, bluebirds, thrushes, pipits, waxwings, warblers,

⁷² Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

⁷³ Marine mammals are described in further detail in Section 7.1.6.5, Fisheries and Aquatic Habitats.

⁷⁴ Accidental: “Birds [that] are far from where they naturally occur and they got to [a particular location] by sheer accident. (Texas Parks and Wildlife 1997)

tanagers, towhee, sparrows, buntings, blackbirds, grackles, orioles, finches, grosbeaks, and house sparrows (ODFW, 2016b).

Oregon is within the Pacific Flyway, which spans 4,000 miles (north to south) from the Arctic to the west coast of Mexico, and 1,000 miles (east to west) from the Rocky Mountains to the Pacific Ocean (Ducks Unlimited, 2015). At least a billion birds migrate along the Pacific Flyway and depend on diverse habitats such as the arctic tundra, northwestern rainforest, tropical beaches, and mangroves (National Audubon Society, 2016). The most varied waterfowl habitats in North America are found in the Pacific Flyway (Ducks Unlimited, 2015).

A total of 97 Important Bird Areas (IBA) have been identified in Oregon (Audubon Society of Portland, 2016) (Figure 7.1.6-2). IBAs are selected for their high habitat value and in Oregon all four of the world's major terrestrial biomes can be found; including alpine, desert, grassland, and forest. Oregon also has over 360 miles of coastline. "Goals for the Oregon IBA Program include: 1) Identifying sites in Oregon most important to avian conservation, 2) Increasing local awareness of sites and their importance, 3) Assembling a team of 'friends' to adopt public sites, 4) Initiating volunteer avian and habitat monitoring at most sites, 5) Promoting management and conservation measures that maintain avian values, and 6) Mobilizing resources so that landowners and managers are able to maintain avian values" (National Audubon Society, 2015).

Many species of birds found in Oregon are protected through either the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, or the Endangered Species Act. The bald eagle (*Haliaeetus leucocephalus*) is found throughout the state and the golden eagle (*Aquila chrysaetos*) is common east of the Cascade Range (ODFW, 2016c). Threatened and endangered bird species are discussed in Section 7.1.6.6.

Reptiles and Amphibians

An estimated 63 species of reptiles (e.g., the western painted turtle [*Chrysemys picta*]) and amphibians can be found in Oregon including 19 species of salamander and newts, 12 species of frogs and toads, 2 terrestrial turtles, 3 sea turtles, 12 lizards, and 15 snakes (ODFW, 2016d) (ODFW, 2016e). Aquatic species are discussed further in Section 7.1.6.9. Reptile and amphibian species occur in a wide variety of habitat throughout the state. Threatened and endangered species are discussed in Section 7.1.6.6.

Invertebrates

Oregon is home to a large number of invertebrate species including moths, butterflies, dragonflies, beetles, snails, worms, amphipods, freshwater mussels, and shore bugs (ODFW, 2016f). Threatened and endangered species are discussed in Section 7.1.6.6.

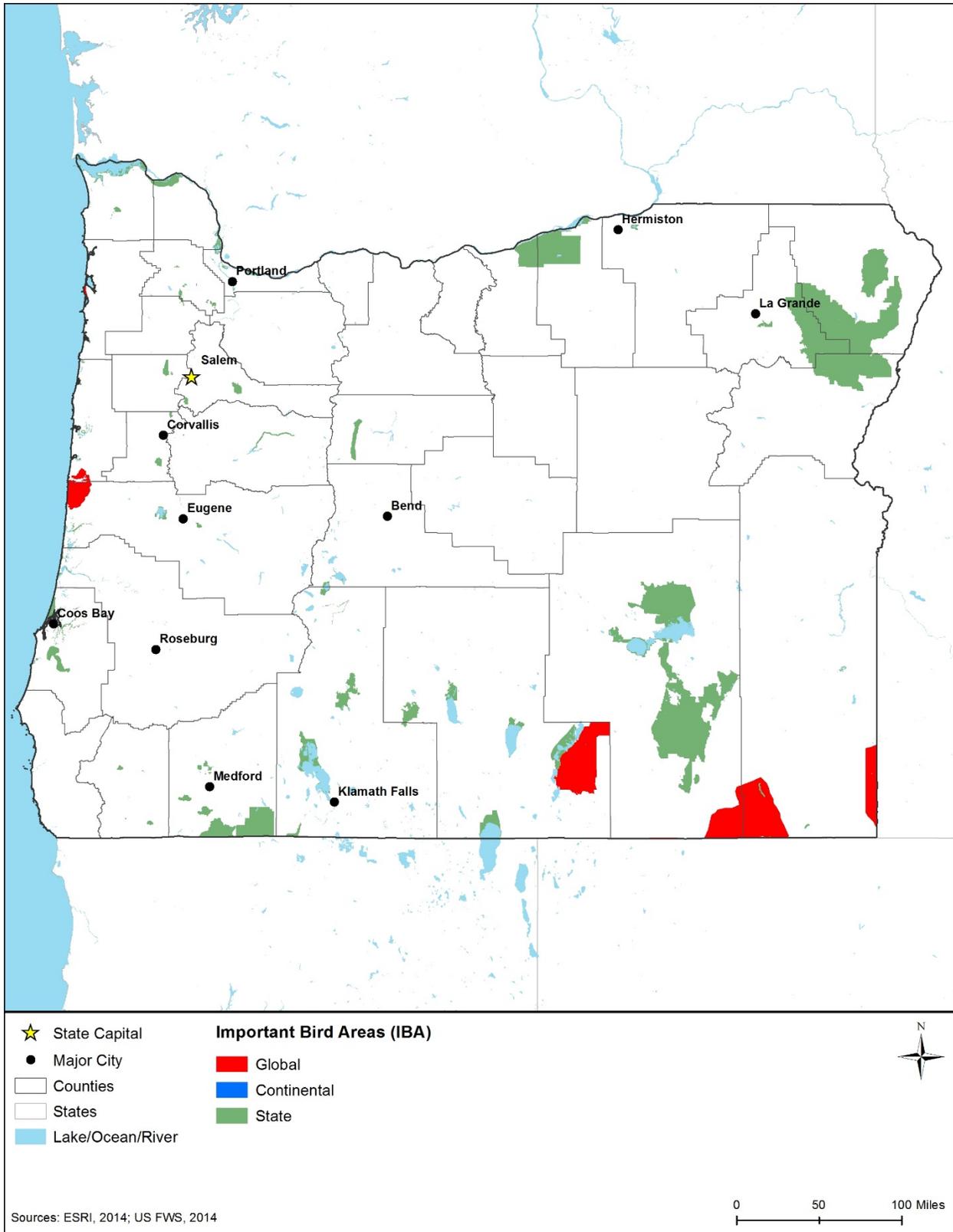


Figure 7.1.6-2: Important Bird Areas in Oregon

7.1.6.5. Fisheries and Aquatic Habitats

This section discusses the aquatic wildlife species in Oregon, including fish, invertebrates, marine mammals, and sea turtles. A summary of non-native and invasive aquatic species is also presented in this section.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act identifies and protects those fish habitats that are necessary for spawning, breeding, feeding, or growth to maturity. These habitats are termed “Essential Fish Habitat” or EFH. NOAA provides an online mapping application and website to provide the public a means to obtain illustrative representations of EFH. This tool is used to identify the existing conditions for a project location to identify sensitive resources.⁷⁵ Oregon Appendix B, Table B2, contains tables summarizing EFH in Oregon.

Under the Magnuson-Stevens Act, the National Marine Fisheries Service also considers a second, more limited habitat designation for each species in addition to EFH. Habitat Areas of Particular Concern (HAPC) are described as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. In general, HAPCs include high value intertidal and estuarine habitats, offshore areas of high habitat value or vertical relief, and habitats used for migration, spawning, and rearing of fish and shellfish. HAPCs are not afforded any additional regulatory protection under the Magnuson-Stevens Act; however, federal actions with potential adverse impacts to HAPC will be more carefully scrutinized during the consultation process and will be subject to more stringent EFH conservation recommendations (NOAA, 2016a). Off the Oregon Coast Estuaries, kelp canopy, seagrass, rocky reefs are considered HPACs. In addition, Daisy Bank/Nelson Island, Thompson Seamount, and President Jackson Seamount are discrete areas of interest that have been designated as HAPCs (NOAA, 2016b).

Five federal fishery management plans and their associated EFH are applicable to projects within the state of Oregon: the Pacific Coast Groundfish Fishery, the Coastal Pelagic Species Fishery, the Highly Migratory Species, the Pacific Halibut Catch Sharing Plan, and the Pacific Coast Salmon Fishery. The Pacific Coast Groundfish Fishery includes more than 80 species in Oregon (Pacific Fishery Management Council, 2016a); the Coastal Pelagic Fishery includes Pacific sardine, Pacific mackerel, northern anchovy, jack mackerel and the market squid (Pacific Fishery Management Council, 2011); the Highly Migratory Species addresses species of shark, tuna, and billfish (Pacific Fishery Management Council, 2016b); the Pacific Halibut Catch Sharing Plan only applies to halibut (Pacific Fishery Management Council, 2016c); and the Pacific Salmon Fishery includes chinook and coho salmon (Pacific Fishery Management Council, 2016d). Oregon Appendix B, Table B-1, presents a summary of EFH offshore of Oregon.

⁷⁵ NOAA’s Essential Fish Habitat Mapper v 3.0 was used to identify “EFH areas of particular concern” and “EFH areas protected from fishing.” As of July 2016, the procedure to use this interactive tool is as follows: 1) Visit <http://www.habitat.noaa.gov/protection/efh/habitatmapper.html>. 2) Select “EFH Mapper” under Useful Links. 3) After closing the opening tutorial, select the “Region” of interest from the drop-down menu. 4) Select the species under “Essential Fish Habitat” to view the areas in the selected region protected for the various life states (i.e., eggs, larvae, juvenile, adult, or all).

Fish are divided into freshwater and saltwater species, although many of Oregon's fish are diadromous (i.e., anadromous⁷⁶ and catadromous⁷⁷), reflecting the state's location along the Pacific coast and the variety of aquatic habitats that it provides.

Freshwater Fish

Many native freshwater fish are found in Oregon, in habitats ranging from desert springs to small mountain streams to large tidal rivers. Freshwater fish are ecologically components of their ecosystems, and play a significant spiritual, cultural, and economic role for many tribes and citizens of Oregon. Major freshwater sportfish in Oregon include trout, steelhead, and salmon (ODFW, 2016g). A summary of freshwater fish families in Oregon are listed in Table 7.1.6-4 (ODFW, 2016h). Threatened and endangered species are discussed in Section 7.1.6-7.

⁷⁶ Anadromous: "Referring to the lifecycle of fishes, such as salmon, in which adults travel upriver from the sea to breed, usually returning to the area where they were born" (USEPA, 2015s).

⁷⁷ Catadromous: "An organism which lives in fresh water and goes to the sea to spawn, such as some eels" (USEPA, 2015s).

Table 7.1.6-4: Oregon’s Native Freshwater Fish Species

<p>Minnows (Cyprinidae)</p> <ul style="list-style-type: none"> • Alvord chub (<i>Gila alvordensis</i>) • Blue chub (<i>Gila coerulea</i>) • Borax Lake chub (<i>Gila boraxobius</i>) • California roach (subspecies “Pit roach” in Oregon) (<i>Hesperoleucus symmetricus</i>) • Chiselmouth (<i>Acrocheilus alutaceus</i>) • Lahontan redband (<i>Rhinichthys egregious</i>) • Leopard dace (<i>Rhinichthys falcatus</i>) • Longnose dace (<i>Rhinichthys cataractae</i>) • Northern pikeminnow (<i>Ptychocheilus oregonensis</i>) • Oregon chub (<i>Oregonichthys crameri</i>) • Peamouth (<i>Mylocheilus caurinus</i>) • Redside shiner (<i>Richardsonius balteatus</i>) • Speckled dace (<i>Rhinichthys osculus</i>) • Tui chub (<i>Gila bicolor</i>) • Umatilla dace (<i>Rhinichthys umatilla</i>) • Umpqua chub (<i>Oregonichthys kalawatseti</i>) • Umpqua dace (<i>Rhinichthys evermanni</i>) • Umpqua pikeminnow (<i>Ptychocheilus umpquae</i>) <p>Suckers (Catostomidae)</p> <ul style="list-style-type: none"> • Bridgelip sucker (<i>Catostomus columbianus</i>) • Klamath largescale sucker (<i>Catostomus snyderi</i>) • Klamath smallscale sucker (<i>Catostomus rimiculus</i>) • Largescale sucker (<i>Catostomus macrocheilus</i>) • Lost River sucker (<i>Deltistes luxatus</i>) • Modoc sucker (<i>Catostomus microps</i>) • Mountain sucker (<i>Catostomus platyrhynchus</i>) • Sacramento sucker (subspecies “Goose Lake sucker” in Oregon) (<i>Catostomus occidentalis</i>) • Sshortnose sucker (<i>Chasmistes brevirostris</i>) • Tahoe sucker (<i>Catostomus tahoensis</i>) • Warner sucker (<i>Catostomus warneri</i>) 	<p>Lamprey (Petromyzontidae)</p> <ul style="list-style-type: none"> • Klamath lamprey (<i>Lampetra similis</i>) • Miller Lake lamprey (<i>Entosphenus minimus</i>) • Pacific lamprey (<i>Entosphenus tridentatus</i>) • Pit-Klamath brook lamprey (<i>Lampetra lethophaga</i>) • River lamprey (<i>Lampetra ayresi</i>) • Western Brook lamprey (<i>Lampetra richardsoni</i>) <p>Sturgeon (Acipenseridae)</p> <ul style="list-style-type: none"> • Green sturgeon (<i>Acipenser medirostris</i>) • White sturgeon (<i>Acipenser transmontanus</i>) <p>Salmon and trout (Salmonidae)</p> <ul style="list-style-type: none"> • Bull trout (<i>Salvelinus confluentus</i>) • Chinook Salmon (<i>Oncorhynchus tshawytscha</i>) • Chum salmon (<i>Oncorhynchus keta</i>) • Coho salmon (<i>Oncorhynchus kisutch</i>) • Cutthroat trout (<i>Oncorhynchus clarki</i>) • Mountain whitefish (<i>Prosopium williamsoni</i>) • Rainbow trout/Redband trout/Steelhead (<i>Oncorhynchus mykiss</i>) <p>Troutperch (Percidae)</p> <ul style="list-style-type: none"> • Sand roller (<i>Percopsis transmontanus</i>) <p>Cods and Burbot (Gadidae)</p> <ul style="list-style-type: none"> • Burbot (freshwater ling) (<i>Lota lota</i>) <p>Stickleback (Gasterosteidae)</p> <ul style="list-style-type: none"> • Threespine stickleback (<i>Gasterosteus aculeatus</i>) <p>Sculpins (Cottidae)</p> <ul style="list-style-type: none"> • Coastrange sculpin (<i>Cottus aleuticus</i>) • Columbia sculpin (<i>Cottus hubbsi</i>) • Klamath Lake sculpin (<i>Cottus princeps</i>) • Malheur sculpin (<i>Cottus bendirei</i>) • Marbled sculpin (<i>Cottus klamathensis</i>) • Margined sculpin (<i>Cottus marginatus</i>) • Mottled sculpin (<i>Cottus bairdi</i>) • Paiute sculpin (<i>Cottus beldingi</i>) • Pit sculpin (<i>Cottus pitensis</i>) • Prickly sculpin (<i>Cottus asper</i>) • Reticulate sculpin (<i>Cottus perplexus</i>) • Riffle sculpin (<i>Cottus gulosus</i>) • SHorthead sculpin (<i>Cottus confusus</i>) • Slender sculpin (<i>Cottus tenuis</i>) • Torrent sculpin (<i>Cottus rhotheus</i>)
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Source: (ODFW, 2016h)

Saltwater Fish

Coastal and offshore waters of Oregon provided habitat to numerous species of saltwater and anadromous fish, including flatfish, rockfish, sharks, skates, and other finfish. Many of these fish species have substantial recreational and commercial fishing value. Commonly caught species in Oregon offshore waters include halibut, tuna, and salmon, and nearshore waters include rockfish, other groundfish, and surfperch (ODFW, 2016g). Table 7.1.6-5 presents a summary of popular Oregon sportfish, including offshore species. A summary of nearshore saltwater fish families and groups in Oregon is listed in Table 7.1.6-6 (ODFW, 2016h). Threatened and endangered species are discussed in Section 7.1.6-7.

Table 7.1.6-5: Popular Saltwater Sportfish Species in Oregon

Common Name	General Habitat
North Coast (Columbia River to Nestucca Bay)	
Albacore	Open seas and clear water, seldom close to shore
Herring, Anchovy, and Sardine	Found in bays
Salmon (coho, chinook, steelhead, cutthroat trout)	Found in booth deep and upper waters in bays and estuaries
Sturgeon (white)	Dwell on the bottom of deep holes in upper bays
Groundfish (rockfish, lingcod, cabezon, greenling)	Prefers rocks and jetties and does not venture far from cover
Central Coast (Cascade Head to Florence)	
Albacore	Open seas and clear water, seldom close to shore
Herring, Anchovy, and Sardine	Found in bays
Salmon (coho, chinook, steelhead, cutthroat trout)	Found in booth deep and upper waters in bays and estuaries
Sturgeon (white)	Dwell on the bottom of deep holes in upper bays
Groundfish (rockfish, lingcod, cabezon, greenling, flatfish)	Prefers rocks and jetties and does not venture far from cover
Pacific halibut	Gravely bottoms in water 150-500+feet deep
South Coast (Winchester Bay to California Border)	
Albacore	Open seas and clear water, seldom close to shore
Herring, Anchovy, and Sardine	Found in bays
Salmon (coho, chinook, steelhead, cutthroat trout)	Found in booth deep and upper waters in bays and estuaries
Sturgeon (white)	Dwell on the bottom of deep holes in upper bays
Groundfish (rockfish, lingcod, cabezon, greenling, flatfish)	Prefers rocks and jetties and does not venture far from cover
Surfperch (redtail, silver, striped, pile, white, and shiner)	Redtail and silver surfperch are found mostly in the surf. Striped, pile perch, white, and shiner all live near rocks, docks, or pilings in bays
Pacific halibut	Gravely bottoms in water 150-500+feet deep

Source: (ODFW, 2015c)

Table 7.1.6-6: Oregon Nearshore Saltwater Fish Species

<p>Rockfish (Sebastidae)</p> <ul style="list-style-type: none"> • Aurora Rockfish (<i>Sebastes aurora</i>) • Bank Rockfish (<i>Sebastes rufus</i>) • Black Rockfish (<i>Sebastes melanops</i>) • Black and Yellow Rockfish (<i>Sebastes chrysomelas</i>) • Blackgill Rockfish (<i>Sebastes melanostomus</i>) • Blue Rockfish (<i>Sebastes mystinus</i>) • Bocaccio Rockfish (<i>Sebastes paucispinis</i>) • Brown Rockfish (<i>Sebastes auriculatus</i>) • China Rockfish (<i>Sebastes nebulosus</i>) • Copper Rockfish (<i>Sebastes caurinus</i>) • Cowcod Rockfish (<i>Sebastes levis</i>) • Darkblotched Rockfish (<i>Sebastes crameri</i>) • Gopher Rockfish (<i>Sebastes carnatus</i>) • Grass Rockfish (<i>Sebastes rastrelliger</i>) • Greenspotted Rockfish (<i>Sebastes chlorostictus</i>) • Greenstriped Rockfish (<i>Sebastes elongates</i>) • Harlequin Rockfish (<i>Sebastes variegatus</i>) • Northern Rockfish (<i>Sebastes polyspinis</i>) • Pacific Ocean Perch (<i>Sebastes alutus</i>) • Puget Sound Rockfish (<i>Sebastes emphaeus</i>) • Pygmy Rockfish (<i>Sebastes wilsoni</i>) • Quillback Rockfish (<i>Sebastes maliger</i>) • Redbanded Rockfish (<i>Sebastes babcocki</i>) • Redstripe Rockfish (<i>Sebastes proriger</i>) • Rosethorn Rockfish (<i>Sebastes helvomaculatus</i>) • Rosy Rockfish (<i>Sebastes rosaceus</i>) • Rougheye Rockfish (<i>Sebastes aleutianus</i>) • Sharpchin Rockfish (<i>Sebastes zacentrus</i>) • Shortbelly Rockfish (<i>Sebastes jordani</i>) • Shortraker Rockfish (<i>Sebastes borealis</i>) • Silvergray Rockfish (<i>Sebastes brevispinis</i>) • Speckled Rockfish (<i>Sebastes ovalis</i>) • Splitnose Rockfish (<i>Sebastes diploproa</i>) • Stripetail Rockfish (<i>Sebastes saxicola</i>) • Tiger Rockfish (<i>Sebastes nigrocinctus</i>) • Vermilion Rockfish (<i>Sebastes miniatus</i>) • Widow Rockfish (<i>Sebastes entomelas</i>) • Yelloweye Rockfish (<i>Sebastes ruberrimus</i>) • Yellowmouth Rockfish (<i>Sebastes reedi</i>) • Yellowtail Rockfish (<i>Sebastes flavidu</i>) 	<p>Flatfish (Bothidae, Pleuronectidae, Cynoglossidae and Soleidae)</p> <ul style="list-style-type: none"> • Arrowtooth Flounder (<i>Atheresthes stomias</i>) • Butter Sole (<i>Pleuronectes isolepis</i>) • Curlfin Sole (<i>Pleuronichthys decurrens</i>) • Dover Sole (<i>Microstomus pacificus</i>) • English Sole (<i>Sebastes melanostomus</i>) • Flathead Sole (<i>Hippoglossoides elassodon</i>) • Pacific Halibut (<i>Hippoglossus stenolepis</i>) • Pacific Sanddab (<i>Citharichthys sordidus</i>) • Petrale Sole (<i>Eopsetta jordani</i>) • Rex Sole (<i>Errex zachirus</i>) • Rock Sole (<i>Pleuronectes bilineatus</i>) • Sand Sole (<i>Psettichthys melanostictus</i>) • Starry Flounder (<i>Platichthys stellatus</i>) <p>Sharks (Triakidae, Squatinidae, and Lamnidae)</p> <ul style="list-style-type: none"> • Leopard Shark (<i>Triakis semifasciata</i>) • Pacific Angel Shark (<i>Triakis semifasciata</i>) • Salmon Shark (<i>Lamna ditropis</i>) • Soupfin Shark (<i>Galeorhinus galeus</i>) <p>Skates (Rajidae)</p> <ul style="list-style-type: none"> • Big Skate (<i>Raja binoculata</i>) • Black Skate (<i>Bathyraja trachura</i>) • Longnose Skate (<i>Raja rhina</i>) • Sandpaper Skate (<i>Bathyraja kincaidii</i>) <p>Other Saltwater Finfish (various families)</p> <ul style="list-style-type: none"> • Cabezon (<i>Scorpaenichthys marmoratus</i>) • Electric Ray (<i>Torpedo californica</i>) • Jack Mackerel (<i>Trachurus symmetricus</i>) • Kelp Greenling (<i>Hexagrammos decagrammus</i>) • Lingcod (<i>Ophiodon elongates</i>) • Longspine Thornyhead (<i>Sebastolobus altivelis</i>) • Pacific (Chub) Mackerel (<i>Scomber japonicas</i>) • Pacific Cod (<i>Gadus microcephalus</i>) • Pacific Grenadier (<i>Coryphaenoides acrolepis</i>) • Pacific Herring (<i>Clupea pallasii</i>) • Pacific Hake (<i>Merluccius productus</i>) • Red Irish Lord (<i>Hemilepidotus hemilepidotus</i>) • Redtail Surfperch (<i>Amphistichus rhodoterus</i>) • Rock Greenling (<i>Hexagrammos lagocephalus</i>) • Sablefish (<i>Anoplopoma fimbria</i>) • Shortspine Thornyhead (<i>Sebastolobus alascanus</i>) • Wolf-Eel (<i>Anarrhichthys ocellatus</i>)
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Source: (ODFW, 2016q)

Shellfish and Other Invertebrates

Oregon is home to a large number of shellfish and other aquatic and wetland invertebrates. Oregon has an important shellfishing industry and the state of Oregon regulates the management of shellfish farming to reduce the threat of contamination and overharvesting. The following species can be found in offshore waters of Oregon: abalone, rock scallops, razor clams, bay clams, softshell clams, piddock clams, purple varnish clams, red rock crab, Dungeness crab, shrimp, prawns, oysters, mussels, mud and ghost shrimp, octopus, squid, sand crabs, mole crabs, Kelp and sand worms, urchins, chitons, snails, shore crabs, anemones, and sea starts (ODFW, 2016i).

Marine Mammals

An estimated 29 different species of marine mammals occur in coastal waters including whales, dolphins, porpoises, and pinnipeds. Pinnipeds found in Oregon may occur in oceans, estuaries, and coastal rivers, porpoises prefer near shore, estuaries, and bays, while whales and dolphins occur primarily in offshore coastal waters. Common species observed in Oregon waters include Pacific harbor seals, northern fur seal, northern elephant seals, the Steller sea lion, the California sea lion, the gray whale, the Pacific white-sided dolphin, harbor porpoise, Dall's porpoise, bottlenose dolphin, sperm whale, humpback whale, minke whale, blue whale (ODFW, 2016j). Less common species include the sei whale, fin whale, fin whale, short-beaked common dolphin, short-finned pilot whale, Risso's dolphin, northern right whale dolphin, killer whale, false killer whale, striped dolphin, pygmy sperm whale, dwarf sperm whale, Baird's beaked whale, Hubbs' beaked whale, Stejneger's beaked whale, and Cuvier's beaked whale. (ODFW, 2014) (ODFW, 2016j)

Sea Turtles

Three species of sea turtles occur in Oregon; they are the leatherback turtle, the loggerhead turtle, and Olive Ridley turtle. These species are discussed in more detail in Section 7.1.6.6, Threatened and Endangered Species.

Invasive Aquatic Species

The Oregon Aquatic Invasive Species Prevention Program is co-managed by both ODFW and the Oregon State Marine Board, with conservation being the primary goal. There many of aquatic nuisance species documented in the state which are causing or have the potential to cause economic or environmental harm; including the following (ODFW, 2016k) (Oregon Department of Agriculture (Plant Division), 2007):

- American Bullfrog (*Lithobates catesbeianus*),
- Asian carp [including bighead carp (*Hypophthalmichthys nobilis*), black carp (*Mylopharyngodon piceus*), grass carp (*Ctenopharyngodon idella*), and silver carp (*Hypophthalmichthys molitrix*)],
- Chinese mystery snail (*Cipangopaludina chinensis*),
- Chinese mitten crab (*Eriocheir sinensis*),
- Common snapping turtle (*Chelydra serpentina*),

- Eurasian watermilfoil (*Myriophyllum spicatum*),
- Hydrilla (*Hydrilla verticillata*),
- Japanese mystery snails (*Cipangopaludina japonica*),
- Northern-ringed crayfish (*Orconectes neglectus*),
- New Zealand mud snail (*Potomopyrgus antipodarum*),
- Oriental weatherfish (*Misgurnus anguillicaudatus*),
- Quagga mussel (*Dreissena rostriformis bugensis*),
- Red-eared slider (*Trachemys scripta elegans*),
- Red swamp crayfish (*Procambarus clarkii*),
- Rusty crayfish (*Orconectes rusticus*), and
- Zebra mussel (*Dreissena polymorpha*).

7.1.6.6. *Threatened and Endangered Species*

The USFWS is responsible for administering the ESA (16 U.S.C. §1531 et seq.) in Oregon. The USFWS has identified 22 federally endangered and 34 federally threatened species known to occur in Oregon⁷⁸ (USFWS, 2015c), note that the list of threatened species includes separate listings for four evolutionarily significant units for the Chinook salmon (*Oncorhynchus tshawytscha*) and four distinct population segments of the steelhead trout (*Oncorhynchus mykiss*). Four candidate species⁷⁹ are identified by USFWS as occurring within the state (USFWS, 2015d). Candidate species are not afforded statutory protection under the ESA. However, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014a). Of the 50 distinct species that are federally listed species, 30⁸⁰ of them have designated critical habitat⁸¹ (USFWS, 2015e). The 22 federally endangered and 34 federally threatened species include 3 mammals, 6 birds, 19 fish, 3 reptiles, 1 amphibian, 4 invertebrates, and 20 plants; 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.

⁷⁸ The USFWS ECOS list identifies species with distinct population segments or geographically isolated populations as individual species in the total species count. This PEIS describes the ESA-listed species with descriptions for the geographic distinctions and does not count them as different types of list species unless distinct populations are listed as threatened and endangered. Therefore, this PEIS has ESA listed species totals that differ slightly than the reported ECOS total, but covers the same species.

⁷⁹ Candidate species are plants and animals that the USFWS has “sufficient information on their biological status and threats to propose them as endangered or threatened under the ESA, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.” (USFWS, 2014a)

⁸⁰ Critical habitats are designated by species; however, this includes species with distinct population segments or geographically isolated populations. This PEIS describes the ESA-listed species with descriptions for the geographic distinctions and does not count them as different types of listed species unless distinct populations are identified as threatened and endangered. Therefore, this PEIS will have critical habitat totals that differ slightly than the reported ECOS total, but cover the critical habitats for the same species.

⁸¹ 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)) (USEPA, 2015s)

Mammals

Two endangered and one threatened mammal species are federally listed and known to occur in Oregon (Table 7.1.6-7). The Canada lynx (*Lynx canadensis*) occurs in boreal forests throughout Oregon. The Columbian white-tailed deer (*Odocoileus virginianus leucurus*) occurs along the Columbia River in northwestern Oregon. The gray wolf (*Canis lupus*) occurs in mountainous, forested habitat in central to southern Oregon. The red tree vole (*Arborimus longicaudus*) and the Washington ground squirrel (*Urocitellus washingtoni*) have been identified as candidate species in Oregon, but will not be discussed in detail below. Further information on the habitat, distribution, and threats to the survival and recovery of the listed species in Oregon is provided below.

Table 7.1.6-7: Federally Listed Mammal Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Canada Lynx	<i>Lynx canadensis</i>	T	No	Boreal forests inhabited by spruce and fir. Found in the Willamette Valley, Cascade Range, Steens Mountain, Stinkingwater Blue Mountains, and the Wallowa Mountains, including Klamath and Lake Counties, in southern Oregon.
Columbian White-tailed Deer	<i>Odocoileus virginianus leucurus</i>	E	No	Bottomlands and prairie woodlands of river basins. Found along the Columbia River in Clatsop, Columbia, and Multnomah Counties, northwestern Oregon.
Gray Wolf	<i>Canis lupus</i>	E	No	Suitable habitat includes mountainous, forested habitat. Found in 9 counties in central to southern Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

Terrestrial Mammals

Canada Lynx. The Canada lynx is an average-sized cat (ranging from 30 to 35 inches long and 14 to 31 pounds) with “large, well-furred paws, long, black ear tufts, and a short, black-tipped tail” that differentiates it from a bobcat (USFWS, 2013a). This cat inhabits boreal forests dominated by spruce and fir, and is skilled at hunting in deep snow. Their primary prey is the snowshoe hare (*Lepus americanus*) and as a result, the abundance and survival of the Canada lynx is directly related to the density and health of regional snowshoe hare populations. The species was listed as endangered in 2000 (65 FR 16053 16086, March 24, 2000). Only a few places in the lower 48 states regularly support the Canada lynx



Canada lynx

Photo Credit: USFWS

populations. In Oregon, it has been found in the Willamette Valley, the Cascade Range, Steens Mountain, the Stinkingwater Blue Mountains, and the Wallowa Mountains, including Klamath and Lake Counties, in the southern part of the state. (ODFW, 2015d) (USFWS, 2015f)

The Canada lynx was listed in 2000 primarily due to concerns over habitat destruction, the need for more regulatory control, and consistent guidance for forest management activities. Given the lynx travels back and forth between the U.S. and Canada, contiguous habitat is important for this species. In addition, snowshoe hare habitat is also important because of the direct link between snowshoe hare abundance and lynx abundance and survival. (ODFW, 2015d)

Columbian White-tailed Deer. The Columbian white-tailed deer is red-brown in color in the summer and gray in the winter, and has white rings around the eyes and behind the nose (USFWS, 2015g). It has a longer tail than the similar mule and black-tail deer. Their tails have brown coloring on the dorsal (upper) surface, and adult male white-tail deer have distinguished antlers “with prongs arising from a single main beam” (USFWS, 2015h). The Columbian white-tailed deer was federally listed as endangered in 1967 (32 FR 4001, March 11, 1967). Regionally, this species is found along the Columbia River in Oregon and Washington. In Oregon, it can be found along the Columbia River in Clatsop, Columbia, and Multnomah Counties, in the northwestern part of the state (USFWS, 2015h).

It inhabits the bottomlands and prairie woodlands of river basins. The Columbian white-tailed deer are considered browsers that graze and forage along the densely forested riversides and grasslands along the Columbia River. The main threat to the Columbian white-tailed deer is habitat loss, fragmentation, and modification, although these have become less of a threat. (USFWS, 2015g)

Gray Wolf. The gray wolf ranges in color to black, white, or gray. Adults weigh between 70 to 110 pounds. Gray wolves are a highly social species and live in packs. Wolves hunt with their pack and feed primarily on deer, elk, and moose. Gray wolves were federally listed as endangered in 1978 (43 FR 9607 9615, March 9, 1978). The endangered population of this species is found in California, Michigan, Oregon, Washington, and Wisconsin. In Oregon, it can be found in nine counties in central to southern parts of the state. (USFWS, 2015i).

Suitable habitat includes mountainous, forested habitat. Wolves are considered “habitat generalists” and therefore can inhabit a wide range of habitats. Primary reasons for species decline included conflicts with humans such as unregulated hunting, resulting in gray wolves becoming eradicated from most of their range within the continental United States (USFWS, 2015j). In 2015, seven deaths of gray wolves were reported in Oregon, four of which had causes of death determined. Three gray wolves were shot illegally, and one was poisoned (ODFW, 2016l).

Birds

One endangered, and five threatened bird species are federally listed for Oregon as summarized in Table 7.1.6-8. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oregon is provided below.

Table 7.1.6-8: Federally Listed Bird Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Marbled Murrelet	<i>Brachyramphus marmoratus</i>	T	Yes, portions of western Oregon.	Spends most of its time on the ocean, roosting and feeding, but moves inland to nest in old-growth forest stands. Found in 17 counties in western Oregon.
Northern Spotted Owl	<i>Strix occidentalis caurina</i>	T	Yes, portions of Oregon.	Structurally complex older forests. Found in 23 counties throughout Oregon.
Short-tailed Albatross	<i>Phoebastria albatrus</i>	E	No	Marine habitats and coastal upwelling areas. Found in 7 counties along the Oregon coast.
Streaked Horned Lark	<i>Eremophila alpestris strigata</i>	T	Yes, in Clatsop, Columbia, Marion, Polk, and Benton Counties in Oregon.	Open spaces with no trees and few to no shrubs. Found in 11 counties in western Oregon.
Western Snowy Plover	<i>Charadrius alexandrinus nivosus</i>	T	Yes, in Clatsop, Tillamook, Lane, Douglas, Coos, and Curry Counties, Oregon.	Sparsely vegetated sandy beaches in 8 counties along the Oregon coast.
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	T	No	Riparian forested habitat dominated by cottonwood and willow trees. Found in 15 counties throughout Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

Marbled Murrelet. The marbled murrelet is a small diving seabird. Males and females are similar in appearance, and are chubby birds with short necks. Upperparts are dark brown to blackish in color during breeding season and gray in winter. The belly and throat are a mottled white during breeding season, and in winter the breast has dark marks on the sides, and white surrounding the eye. The marbled murrelet was federally listed as threatened in 1992 (57 FR 45328 45337, October 1, 1992) (USFWS, 2015k). Critical habitat for this species was designated in 2011 (76 FR 61599 61621, October 5, 2011) in Washington, Oregon, and California (USFWS, 2011a). Regionally, this species is found in California, Oregon, and Washington. In Oregon, it can be found in 17 counties in the western part of the state (USFWS, 2015k).

The marbled murrelet feeds primarily on fish and invertebrates in near-shore marine waters. It spends most of its time on the ocean, roosting, and feeding, but moves inland to nest in old-growth forest stands. Large trees containing large branches or deformities for use as nest platforms characterize nesting habitat. Larger, unfragmented stands of old growth appear to be the highest quality habitat for marbled murrelet nesting. Nesting stands in Oregon are typically dominated by old growth Douglas fir (USFWS, 2011a). The primary threats to the marbled

murrelet are habitat loss (primarily from logging), bycatch in gill-net fisheries, and oil spills (USFWS, 2011a) (Carter, McAllister, & Isleib, 1995).

Northern Spotted Owl. The northern spotted owl is a medium sized dark brown owl with light colored spots on its head and breast (USFWS, 2015l). The owl was federally listed as threatened in 1990 (55 FR 26114 26194, June 26, 1990). Critical habitat was designated in 2012 (77 FR 71875 72068, December 4, 2012) in California, Oregon and Washington including areas west and east of the Cascades (USFWS, 2012a). This species is found in Canada, California, Oregon, and Washington. In Oregon, it can be found in 23 counties throughout the state (USFWS, 2015l).

It inhabits structurally complex older forests because they contain the required features for nesting, roosting, and foraging. Northern spotted owls are highly territorial and maintain large home ranges. They primarily prey on small mammals. Threats to this species include habitat loss, which has occurred because of forest conversion, timber harvest, fires, and insect infestation and from the competition from the barred owl. (USFWS, 2012a)

Short-tailed Albatross. The short-tailed albatross is a large pelagic bird with long wings. It has a large hooked pink bill with a black border around the base. The short-tailed albatross is distinguished by its all white back (USFWS, 2000a); (USFWS, 2015m). The short-tailed albatross was federally listed as endangered in the United States in 2000 (65 FR 46643 46654, July 31, 2000), an administrative error in the original 1970 listing (35 FR 6069, April 14, 1970) listed the bird throughout its range with the exception of the United States population. The species uses the marine habitat along the coast for foraging. In Oregon, it can be found in seven counties along the coast (USFWS, 2015m).

Short-tailed Albatross nest in isolated off shore islands that have flat or sloped ground and sparse or full ground vegetation. Females lay one egg per breeding season. They feed in marine waters off fish, squid, and crustaceans in areas coastal upwelling. Threats to the short-tailed Albatross include loss of nesting habitat, pollution, and incidental loss due to offshore fishing (USFWS, 2000a).

Streaked Horned Lark. The streaked horned lark is a small, ground-dwelling bird that grows approximately 6 to 8 inches in length. It has a dark brown colored back, yellowish underparts, walnut brown back of the neck, and a yellow throat and eyebrow stripe. This subspecies can be distinguished from other horned larks by its smaller size, darker back coloring, and more yellow coloration beneath (USFWS, 2015n). It has a short, thin bill, and a short neck and rounded head. It also has distinctive “black horns” which are feather tufts. This species was federally listed as threatened in 2013 (78 FR 61451 61503, October 3, 2013) (USFWS, 2015o). Critical habitat was also designated in 2013 (78 FR 61505 61589, October 3, 2013) in Clatsop, Columbia, Marion, Polk, and Benton Counties in Oregon (USFWS, 2013b). This species is found in the Puget lowlands in Washington, the Washington coast and lower Columbia River islands, and the Willamette Valley in Oregon (USFWS, 2015n). In Oregon, it can be found in 11 counties in the western part of the state (USFWS, 2015o).

It inhabits open spaces with no trees and few to no shrubs. It nests on the ground in areas with little vegetation that are dominated by grasses and herbaceous flowering plants. Its nesting habitat includes a broad range of environments, such as native prairies, coastal dunes, agricultural fields, wetland mudflats, edges of grass fields, pastures, airports, gravel roads, dredge deposition sites, and recently planted Christmas tree farms. Threats to the streaked horned lark include habitat loss and modification due to conversion to agriculture and industry, loss of natural disturbances such as fire and flooding, invasion of nonnative plants, and incompatible management practices. (USFWS, 2015n)

Western Snowy Plover. The western snowy plover is a small shorebird, approximately 6 inches long. It has a thin, dark bill, white forehead, and eyebrow line, with black patches above the forehead and behind the eye. Its upper parts are pale brown to gray in color, its belly is white or buff colored, and it has darker patches on its shoulders and head. Its dark gray to black colored legs distinguishes the western snowy plover from other plovers. The Pacific coast population breeds on coastal beaches from southern Washington down to southern Baja California, Mexico (USFWS, 2014b). The species was listed as federally threatened in 1993 (58 FR 12864 12874, March 5, 1993) (USFWS, 2015p). In 2012 (77 FR 36727 36869, June 19, 2012), critical habitat was designated in Clatsop, Tillamook, Lane, Douglas, Coos, and Curry Counties, Oregon (USFWS, 2012b). In Oregon, the western snowy plover can be found in eight counties along the coast (USFWS, 2015p).

Its breeding and nesting habitat is above the high tide line on coastal beaches, sand spits, dune-backed beaches, sparingly vegetated dunes, beaches at the mouths of creeks and rivers, and salt pans at lagoons and estuaries. Nesting habitat occurs throughout its range, but could be separated by expanses of rocky shoreline. The main threat to the western snowy plover is its poor reproductive success due to human disturbance, predation, extreme weather, and the introduction of nonnative plants. Human disturbances to nesting sites, like walking, jogging, running pets, horseback riding, and vehicle use are direct causes for the decline in breeding sites and western snowy plover populations, resulting in abandonment of nest sites and reductions in nesting density and success. (USFWS, 2014b)

Yellow-billed Cuckoo (Western). “Yellow-billed Cuckoos are fairly large, long, and slim birds. The mostly yellow bill is almost as long as the head, thick, and slightly downcurved. They have a flat head, thin body, and very long tail. Wings appear pointed and swept back in flight. Yellow-billed Cuckoos are warm brown above and clean whitish below. Their blackish face mask is accompanied by a yellow eyering” (USFWS, 2015q). This shy, migrant bird winters in South America and breeds in the western U.S. The western yellow-billed cuckoo is considered a separate population from its eastern counterpart. Currently, the majority of breeding pairs of the western yellow-billed cuckoo are found in Arizona, California, Colorado, Idaho, New Mexico, and Utah (Johnson, 2009). This species was federally listed as threatened in 2014 (79 FR 59992 60038, November 12, 2014). The western population occurs from the West coast to the Midwest. In Oregon, it can be found in 15 counties throughout the state (USFWS, 2015q).



Yellow-billed cuckoo

Photo Credit: USFWS

Preferred habitat consists of riparian forested habitat dominated by cottonwood and willow trees, and in particular contiguous stands of these tree species that exceed 25 acres in size. This species does not tend to breed in forested areas with minimal canopy cover and invasive species. 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, 2014d)

Fish

Although a total of 13 species are included in the table and discussion below, there are four endangered and 15 threatened fish species are federally listed for Oregon as summarized in Table 7.1.6-9. The federal listing is inclusive of the four evolutionarily separate units of Chinook salmon and four distinct population segments of the steelhead trout. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oregon is provided below.

Table 7.1.6-9: Federally Listed Fish Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Borax Lake Chub	<i>Gila boraxobius</i>	E	Yes, 640 acres of the Borax Lake area, Harney County, Oregon.	Borax Lake, which is a natural lake that gets its water from several highly variable thermal springs. Found in Borax Lake and its

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
				surrounding wetlands in the Alvord Basin, Harney County, Oregon.
Bull Trout	<i>Salvelinus confluentus</i>	T	Yes, in 22 counties throughout Oregon.	Cold streams, rivers, reservoirs and lakes throughout Oregon.
Chinook Salmon ^b	<i>Oncorhynchus tshawytscha</i>	T	Yes, for 2 ESUs in western Oregon.	Freshwater and marine habitats including the Columbia River, Snake River, and the Willamette River, Oregon.
Chum Salmon	<i>Oncorhynchus keta</i>	T	Yes, for 1 ESU in northwestern Oregon.	Freshwater and marine habitats including the Columbia River in Oregon.
Coho Salmon	<i>Oncorhynchus kisutch</i>	T	Yes, for 1 ESU in Oregon	Freshwater and marine habitats including the Columbia River, Willamette River, the Necanicum River, and Floras Lake in Oregon.
Foskett Speckled Dace	<i>Rhinichthys osculus ssp.</i>	T	No	Two springs from pools with a lot of aquatic plants, and a loose sandy bottom. Found in Foskett and Dace springs, in the Coleman subbasin of Oregon.
Hutton Tui Chub	<i>Gila bicolor ssp.</i>	T	No	Hutton Spring, in a springhole that is 17.7 degrees Celsius, ranges from 20 to 40 feet wide, and 15 feet deep; at an elevation of 4,500 feet. Found in Hutton Spring, Lake County, in southern Oregon.
Lahontan Cutthroat Trout	<i>Oncorhynchus clarkii henshawi</i>	T	No	Occurs in cool flowing water within the Lahontan Basin. Found in Harney and Malheur Counties, southeastern Oregon.
Lost River Sucker	<i>Deltistes luxatus</i>	E	Yes, 146 miles of streams and 117,848 acres of lakes and reservoirs in Klamath and Lake Counties, Oregon, and Modoc County, California.	Deeper water of lakes and spawns in springs or tributary streams upstream of its home lake. It prefers areas with gravel or cobble bottoms in springs or in moderate to fast-flowing springs for spawning. Found in Jackson, Josephine, Klamath, and Lake Counties, southern Oregon.
Shortnose Sucker	<i>Chasmistes brevirostris</i>	E	Yes, 136 miles of streams and 123,590 acres of lakes and reservoirs in Klamath and Lake Counties, Oregon, and Modoc County, California.	Shallow, cloudy, productive lakes that are cool in the summer, have enough dissolved oxygen, and are somewhat alkaline. Found in lakes and rivers in Jackson, Josephine, Klamath, and Lake Counties, southern Oregon.

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Sockeye Salmon	<i>Oncorhynchus nerka</i>	E	Yes (Ozette Lake)	Freshwater and marine habitats including portions of the Columbia River.
Steelhead ^b	<i>Oncorhynchus mykiss</i>	T	Yes for 4 DPSs in Oregon	Freshwater and marine habitats including the Columbia River, Willamette River, Hood River, and Snake River.
Warner Sucker	<i>Catostomus warnerensis</i>	T	Yes, Twelvemile Creek, Twentymile Creek, the spillway canal north of Hart Lake, Snyder Creek, and Honey Creek, in Lake County, Oregon.	Streams, rivers, lakes, and sloughs within the Warner Basin, in Lake County, southern Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

^b The Chinook salmon has four evolutionary separate units or reproductively isolated populations in the Lower Columbia River, Snake River fall-run, Snake River spring/summer-run, and Upper Willamette River that are threatened; and the steelhead has four distinct population segments or geographically isolated population in the Lower Columbia River, Middle Columbia River, Snake River Basin, and Upper Willamette River that are threatened. This clarifies that the 13 entries in this Table, do accurately describe the USFWS list of 19 T&E fish species.

Borax Lake Chub. The Borax Lake chub is a dwarf species in the Gila genus. It usually ranges from 1.3 to 2 inches in length, but can reach up to 3.6 inches. It has a large head and eyes, and hooked teeth (USFWS, 2013c). It was listed as endangered by an emergency designation in 1980 (45 FR 35821 35823, May 28, 1980), and fully listed as endangered in 1982 (47 FR 43957 43963). Critical habitat was designated at time of listing in 640 acres of the Borax Lake area in Harney County, Oregon (USFWS, 2015r). It can only be found in Borax Lake and its surrounding wetlands in the Alvord Basin, Harney County, Oregon (USFWS, 2013c).

It inhabits Borax Lake, which is a natural lake that gets its water from several highly variable thermal springs. The lake is small and shallow, with temperatures ranging from 16 to 38 degrees Celsius, and occurs on large sodium-borate deposits in the Alvord Desert. Water flows from the lake into adjacent marshes, small pools, and Lower Borax Lake. Threats to the Borax Lake chub include geothermal energy development in the thermal waters that feed its habitat, modification of the lake’s fragile shorelines, overgrazing by livestock, and off-road vehicle use. (USFWS, 2013c)

Bull Trout. The bull trout is a member of the Salmonidae family with an olive green to bronze colored back covered in pale yellow, orange, or salmon-colored spots. There are two forms of bull trout: resident, which spend their whole lives in the same stream; and migratory, which swim to larger bodies of water over the winter and then migrate back to smaller waters to spawn. Resident bull trout can grow up to 10 inches in length, while migratory bull trout can reach up to 35 inches and weigh up to 32 pounds. The bull trout was federally listed as threatened in 1998 (63 FR 31647 31674, June 10, 1998). (USFWS, 2015s)

Bull trout are found in western Canada, Idaho, Montana, Nevada, Oregon, and Washington. Streams and rivers in Montana and Idaho serve as the headwaters for this species. Bull trout

populations are typically migratory, but not exclusively. Migratory bull trout spawn in smaller streams, and inhabit rivers and lakes during other portions of their lifecycle (USFWS, 2014e). In Oregon, it is found in 20 counties throughout the state (USFWS, 2015s). Critical habitat was designated in 2010 (75 FR 63898 64070, October 18, 2010) in Washington, Oregon, Nevada, Idaho, and Montana. In Oregon, critical habitat is designated within 22 counties throughout the state (USFWS, 2010a).

Similar to other salmonid species, bull trout have specific habitat requirements. They require cold water typically less than 12 degrees Celsius, good water quality, strong migratory corridor connectivity, stable and undisturbed stream channels, and clean gravel substrate for spawning. The greatest threats to this species include fish passage restrictions that lead to habitat fragmentation, impacts to water quality due to land management activities, overfishing, hybridization with other trout species, and the potential for increased water temperatures due to climate change. (USFWS, 2014e)

Chinook Salmon. (Includes four separate evolutionary separate units or reproductively isolated populations in the Lower Columbia River, Snake River fall-run, Snake River spring/summer-run and Upper Willamette River that are threatened.) The Chinook salmon is the largest of the Pacific salmon, averaging 40 pounds and 3 feet when full grown, but can be up to 120 pounds in weight. When at sea, it is blue-green in color on its back, with silver sides. It can be distinguished from the similar looking coho salmon by its larger size, small black spots on the tail, and black coloration along the base of the teeth. They spend approximately 3 months to 2 years in freshwater as juveniles, before migrating to estuarine habitats as smolts, and then to the ocean to feed and mature for approximately 2 to 4 years, before going back to the freshwater streams and rivers where they were born to mate and then die. Chinook prefer deeper and larger streams than ones used by other Pacific salmon. Adult female Chinook make a nest in a stream area that has suitable gravel type, water depth, and current. Chinook spawning areas have larger gravel and more water flow than other Pacific salmon spawning areas. In the U.S., this species occurs from the Bering Strait off Alaska, south to Southern California. Globally, it also occurs along the coast of Siberia and south to Hokkaido Island, Japan (NOAA, 2015c).

Species of Chinook are divided into Evolutionary Significant Units (ESU). Nine Chinook ESUs are listed for protection under the Endangered Species Act, four of which are located in Oregon: the Lower Columbia River, Snake River fall-run, Snake River spring/summer-run, and the Upper Willamette River ESUs. Critical habitat was designated in Oregon for the Lower Columbia River and Upper Willamette River ESUs within their range in the western part of the state (USFWS, 2015t) (65 FR 7764 7787, February 16, 2000). Current threats to this species include human induced changes to habitats caused by poor forestry practices, dams, water diversions, and pollution (NOAA, 2015c).

Chum Salmon. The chum salmon, also called dog salmon, is second only to the Chinook salmon in size, with an average weight of 8 to 15 pounds, although it can grow up to 3.6 feet and 45 pounds. Its large canine-like fangs and bright coloration of spawning males, marked by a bold, jagged, reddish line on the front two-thirds of the body, and jagged black line on the back third, can distinguish this species. Females are not as striking during spawning. When in the

ocean, both sexes are metallic greenish-blue in color along the back, and have black speckles. When they reenter fresh water, they develop a “tiger stripe” pattern of bold red and black stripes. Chum salmon migrate from the ocean back into the freshwater streams and rivers where they were born in order to mate and then die. Unlike most other species that spawn in fresh water, chum salmon form schools, probably to reduce predation. When spawning, it inhabits the lowermost reaches of rivers and streams, usually near streams, and typically within approximately 62 miles of the ocean. Almost immediately after hatching, juveniles migrate to estuarine and ocean waters, unlike other Pacific salmon. (NOAA, 2015d)

This species has the widest range of any Pacific salmon, extending along the shores of the Arctic Ocean, Korea, Japan, and into the far north of Russia. In the U.S., chum salmon occur as far south as Tillamook Bay on the northern Oregon coast, and all the way north through Alaska. Species of chum salmon are divided into ESUs. Two ESUs were federally listed as threatened in 1999 (64 FR 41835 41839 August 2, 1999), one of which is located in Oregon: the Columbia River ESU. Critical habitat was designated in 2000 (65 FR 7764 7787 February 16, 2000) in stream channels in Oregon and Washington for these threatened ESUs. Current threats to this species include human induced changes to habitats caused by poor forestry practices, dams, water diversions, and pollution. (NOAA, 2015d) (USFWS, 2015u)

Coho Salmon. The coho salmon, also called silver salmon, can grow more than 2 feet in length and weigh up to 35 pounds, but the average weight is approximately 8 pounds. It has a dark metallic blue or greenish colored back with silver sides and a light colored belly with small black spots on the back and upper lobe of the tail when in the ocean. The gumline in the lower jaw is lighter in color than in Chinook salmon. When spawning in inland rivers, coho salmon turn dark in color with reddish-maroon sides. Usually at around three years old, adults migrate from the ocean into the freshwater streams and rivers where they were born in order to mate; they spawn once and then die. Some males known as “jacks” migrate and spawn as two year olds. When spawning, males develop a hooked snout and large teeth. Coho salmon spend approximately the first half of their lives in freshwater streams and small tributaries rearing and feeding. The spawning habitat consists of small streams with substrates of stable gravel where females can make nests. The rest of their lives are spent foraging in the estuarine and marine waters of the Pacific Ocean. (NOAA, 2015e)

This species ranges throughout the North Pacific Ocean, from central California to Point Hope Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. The Lower Columbia River ESU was federally listed as threatened in 2005 (50 CFR 223.102, June 28, 2005), the Southern Oregon – Northern California Coast ESU was federally listed as threatened in 1997 (50 CFR 223.102, June 18, 1997), and the Oregon Coast ESU was federally listed as threatened in 2011 (50 CFR 223.102, April 13, 2011).

Critical habitat was designated for the Southern Oregon – Northern California Coast ESU in all rivers between the Mattole River in California and the Elk River in Oregon (NOAA, 1999).

The Lower Columbia River Coho salmon ESU includes coho populations that spawn in streams and tributaries to the Columbia River in Washington and Oregon, from the mouth of the Columbia River up to and including the White Salmon and Hood Rivers, and includes

populations spawning in the Willamette River to Willamette Falls, Oregon, as well as 25 artificially propagated populations. Data on the status of natural-origin Lower Columbia River coho salmon are very limited. Most populations have low or very low numbers. Most of the natural runs have largely been replaced by hatchery production. The Lower Columbia River coho salmon ESU was listed as federally threatened in 2005. Critical habitat for this ESU was designated in 2016 (81 FR 9251 9325, February 24, 2016) with 2,300 stream miles in its range (NOAA, 2016c). Human impacts and limiting factors for the Lower Columbia River coho salmon include habitat degradation (including hydropower development), genetic and ecological effects from hatchery production, and losses from harvest and predation.

The Oregon Coast coho salmon ESU includes coho populations that spawn in streams and tributaries from the Necanicum River to Floras Lake. The Oregon Coast coho salmon ESU was listed as federally threatened in 2011. Human impacts and limiting factors for the Oregon Coast coho salmon are similar to those described for the Lower Columbia River ESU and include habitat degradation (including hydropower development), genetic and ecological effects from hatchery production, and losses from harvest and predation. Critical habitat was designated in 2008 (73 FR 7816 7873, February 11, 2008) for the Oregon Coast ESU in approximately 6,568 stream miles and 15 square miles of lake habitat in its range (NOAA, 2008).

Foskett Speckled Dace. The Foskett speckled dace has a short lateral line, approximately 15 scales with pores, large eyes, and a dorsal fin set farther back (USFWS, 2013d). It was federally listed as threatened in 1985 (50 FR 12302 12306, March 28, 1985) (USFWS, 2015v). It can only be found in Foskett spring, and historically Dace spring which has not been habitable for fish since 1997, in the Coleman subbasin of Lake County, southern Oregon (USFWS, 2013d) (USFWS, 2015v).

It inhabits Foskett and Dace springs, both of which are very small and shallow with limited fish habitat. Foskett Spring comes from a pool approximately 16.4 feet wide, and flows toward Coleman Lake in a shallow, narrow channel. The pool has a lot of aquatic plants, and a loose sandy bottom. Dace Spring is about 0.6 miles south of Foskett Spring and is smaller with more aquatic plants. In Foskett Spring, the Foskett speckled dace is found in the main spring pool, outflow channel, and tiny outflow rivulets that are sometimes only a few inches wide and deep. It finds cover under the overhangs of bank edges, grasses and exposed grass roots, and algae. The main threat to the Foskett speckled dace is its limited habitat and the possibility of even more habitat reduction due to sedimentation and vegetation filling in the area near the spring outflow. (USFWS, 2013d)

Hutton Tui Chub. The Hutton tui chub is “an undescribed subspecies of *Gila bicolor*” (USFWS, 2015w). It is a stout minnow, with the greatest width of its body right behind the head. It can be distinguished from other tui chubs in nearby areas by its head, which is convex in outline, and is longer and deeper, with a bigger distance between the eyes than other tui subspecies (USFWS, 2015w). The Hutton tui chub was federally listed as threatened in 1985 (50 FR 12302 12306, March 28, 1985) (USFWS, 2015x). This species is the only fish found in the Alkali Subbasin in southwestern Oregon. It can only be found in Hutton Spring, Lake County, southern Oregon (USFWS, 2015w).

It inhabits Hutton Spring, in a springhole that is 17.7 degrees Celsius, ranges from 20 to 40 feet wide, and 15 feet deep; at an elevation of 4,500 feet. The Hutton tui chub uses vegetation and other debris in the springhole for cover. The spring's outflow forms a small wetland next to its sources. The habitat surrounding the spring is grassy, bordered by shrubby rangeland to the north and west and by Alkali Lake to the east and south. Threats to the Hutton tui chub include groundwater contamination due to dispersal of chemicals from a nearby herbicide disposal site, and modification of the springs, which causes other issues such as siltation, erosion, vegetation loss, and water diversion. (USFWS, 2015w)

Lahontan Cutthroat Trout. The Lahontan cutthroat trout is an inland subspecies of cutthroat trout. This multi-colored fish species has a greenish yellow body, silver belly, and reddish sides with small and medium round dark colored spots and varies in both size and weight; it can grow between 10 to 50 inches in length and will weigh up to 40 pounds. This species was originally federally listed as endangered in 1970 under the Endangered Species Conservation Act of 1969 and reclassified as threatened in 1975 (40 FR 29863 29864, July 16, 1975) due to extensive culturing and successful reintroductions (USFWS, 1995). Regionally, it can be found in California, Nevada, Oregon, and Utah. In Oregon, it is found in Harney and Malheur Counties, in the southeastern part of the state (USFWS, 2015y).

Suitable habitat for this species occurs in cool flowing water within the Lahontan Basin. It typically feeds on terrestrial and aquatic insects. Primary threats to this species include reduction and alteration of stream discharge, degradation of water quality, reduction of lake levels and introduction of non-native fish species (USFWS, 1995) (USFWS, 2015y).

Lost River Sucker. The Lost River sucker, locally known as mullet, is a large, long-lived fish that can reach up to 43 years in age. It can grow up to approximately 3.3 feet in length and weigh up to approximately 10 pounds. It has dark brown to black colored backs and brassy sides that fade to yellow or white on the belly (USFWS, 2007a) (USFWS, 2015z). The Lost River sucker feeds items suspended the water column⁸² by straining it from the water using “unique triangular-shaped gill structures” (USFWS, 2015z). Adults migrate from lakes into fast moving streams to spawn, usually starting at around nine years of age. They migrate at night and stay in the shallow areas of shorelines and in aquatic vegetation during daytime. Historically, the Lost River sucker was widespread and abundant in the upper Klamath Basin of Oregon and California. Now, it is found in only a fraction of its former range and occurs in a few areas in the Upper Klamath Basin, such as the drainages of Upper Klamath Lake, Tule Lake, and Clear Lake (USFWS, 2015z). The Lost River sucker was federally listed as endangered in 1988 (53 FR 27130 27134, July 18, 1988). Regionally, it is now found in California and Oregon. In Oregon, it can be found in Jackson, Josephine, Klamath, and Lake Counties, in the southern part of the state (USFWS, 2015aa). Critical habitat was designated in 2012 (77 FR 73739 73768, December 11, 2012) in approximately 146 miles of streams and 117,848 acres of lakes and reservoirs in Klamath and Lake Counties, Oregon, and Modoc County, California (USFWS, 2012c).

⁸² Potential food items suspended in the water column are detritus, or decomposing organic matter; zooplankton; algae; and insects.

It inhabits the deeper water of lakes and spawns in springs or tributary streams upstream of its home lake. It prefers areas with gravel or cobble bottoms in springs or in moderate to fast-flowing springs for spawning. The streams used for spawning also have a shallow shoreline with plenty of aquatic vegetation to provide cover for migrating larvae. Threats to the Lost River sucker include poor water quality, reduced suitable habitat, and the impacts of nonnative fishes. (USFWS, 2015z)

Shortnose Sucker. The shortnose sucker has a large head. The mouth has thin but fleshy lips, and the lower lip is notched. It can grow to approximately 20 inches, and can live up to 33 years. It is dark on its back and sides, and silvery or white on its belly (USFWS, 2007a). The shortnose sucker was federally listed as endangered in 1988 (53 FR 27130 27134, July 18, 1988). Regionally, this species is found in California and Oregon, in Upper Klamath Lake and its tributaries, the Lost River, Clear Lake, and the Klamath River and its reservoirs. Within Oregon, it can be found in lakes and rivers in Jackson, Josephine, Klamath, and Lake Counties, in the southern part of the state (USFWS, 2007a) (USFWS, 2015ab).

Critical habitat was designated in 2012 (77 FR 73739 73768, December 11, 2012) in approximately 136 miles of streams and 123,590 acres of lakes and reservoirs in Klamath and Lake Counties, Oregon, and Modoc County, California (USFWS, 2012c). The shortnose sucker prefers shallow, cloudy, productive lakes that are cool in the summer, have enough dissolved oxygen, and are somewhat alkaline. They spawn in the larger tributaries of inhabited lakes, in riffles or runs over gravel or cobble substrates, and moderate current. The main threat to the shortnose sucker is habitat degradation due to reduced water quality. Another threat could be hybridization with other species (USFWS, 2007a).

Sockeye Salmon. Sockeye Salmon on average weigh 8 pounds and grow up to 3 feet long. In the ocean, sockeye salmon are bluish black with silver sides. However, during spawning adults turn bright red with green heads. Sockeye salmon are anadromous fish, they migrate from the sea to spawn in freshwater. The majority of sockeye salmon spawn in or near lakes where juveniles rear before returning to the ocean (NOAA, 2015f). Species of sockeye salmon are divided into ESUs. Two ESUs are listed for protection under the Endangered Species Act, one of which is located in Oregon, the endangered Snake River ESU (64 FR 41835 41839 August 2, 1999). As of 2000, critical habitat has been designated to all lake and river reaches accessible to Ozette Lake in Washington specifically Clallam County (65 FR 7764 7787 February 16, 2000); however, there is no critical habitat in Oregon. Current threats to this species include human induced changes to habitats caused by poor forestry practices, dams, water diversions, and pollution (NOAA, 2015f).

Steelhead Trout. Steelhead Trout are a part of the taxonomic family Salmonidae. They are typically dark-olive in color with shading to silvery-white on the underside (NOAA, 2015g). Steelhead trout are born in fresh water streams and migrate to the ocean where most of their growth occurs. Steelhead then return to the rivers of their birth to spawn. Unlike Pacific salmon, steelhead do not necessarily die after spawning and are able to spawn more than once (USFWS, 2015ac). Steelhead are divided into Distinct Population Segments (DPSs). Eleven steelhead DPSs are listed for protection under the ESA, four of which are in Oregon: Middle Columbia

River, Lower Columbia River, Snake River Basin, and Upper Willamette River. As of 2005, stream channels and lakes have been designated as critical habitat in California, Idaho, Oregon, and Washington (USFWS, 2015ac) for nine of the 111 DPSs of steelhead, including all four in Oregon.

Steelhead trout can tolerate a wide range of water temperatures. Spawning habitat “consists of gravel substrates that are free of excessive silt” (NOAA, 2015g). Current threats to this species include human induced changes to habitats caused by poor forestry practices, dams, water diversions, and pollution (NOAA, 2015g).

Warner Sucker. The Warner sucker is a long, slender fish that is dark brown or tan in color with a creamy white underbelly. Males have a prominent red stripe across their bodies during spawning season. The species reaches a maximum of 18 inches in length (USFWS, 1998a). It was federally listed as threatened and designated critical habitat in 1985 (50 FR 39117 39123, September 27, 1984) (USFWS, 2015ad). Critical habitat for the Warner sucker in Oregon was designated in Twelvemile Creek, Twentymile Creek, the spillway canal north of Hart Lake, Snyder Creek, and Honey Creek in Lake County, Oregon (USFWS, 1985). Regionally, this species is found in California, Nevada, and Oregon. In Oregon, it can be found Lake County, in the southern part of the state (USFWS, 2015ad).

With adequate conditions, the Warner sucker is able to inhabit all natural waterbodies within the Warner Basin. Habitats include streams with aquatic vegetation, deep pools, and protective cover from vegetation or overhanging banks, and lakes with uniform depths and mud bottoms for foraging. The species feeds on a variety of invertebrates, algae, and organic plant material found on the bottoms of lakes and streams. Primary threats to the species include habitat alteration, introduction of predatory or competitive non-native fish species, and water pollution. (USFWS, 1998a)

Reptiles

Two endangered and one threatened reptile species are federally listed for Oregon as summarized in Table 7.1.6-10. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oregon is provided below.

Table 7.1.6-10: Federally Listed Reptile Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	E	Yes, along the coast of Oregon.	Open oceans but can also occur in coastal waters. Found off the coast of Oregon.
Loggerhead Sea Turtle	<i>Caretta caretta</i>	E	No	Open sea environment. Occasional sightings off the Oregon coast.

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Olive Ridley Sea Turtle	<i>Lepidochelys olivacea</i>	T	No	Tropical and warm temperate ocean waters worldwide, spending most of its time in the open ocean. During feeding migrations can travel up the U.S. Pacific coast as far north as Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

Leatherback Sea Turtle. “The leatherback is the largest, deepest diving, and most migratory and wide ranging of all sea turtles.” It is the largest of all sea turtles, reaching 4 to 8 feet long and weighing 500 to 2,000 pounds (USFWS, 2015ae) The leatherback sea turtle was listed as endangered in 1970 (35 FR 8491 8498, June 2, 1970) and was grandfathered into the ESA of 1973 (USFWS, 2015af). The leatherback sea turtle is capable of tolerating a wide range of water temperatures; hence its wide global distribution, including the Atlantic, Pacific, and Indian Oceans. In the eastern Pacific, leatherbacks can be found as far north as Alaska, and as far south as Chile (USFWS, 2015af). Critical habitat was established in 2012 along the coast of California, Oregon and Washington (NMFS, 2012).

Preferred habitat for leatherback sea turtles occurs primarily in open oceans but can also occur in coastal waters. The leatherback sea turtle diet consists of jellyfish, salps (a transparent barrel-shaped tunicate⁸³), and other soft-bodied animals. This species will forage in both coastal waters and the open sea environment (NOAA, 2015h). For reproduction, the female leatherback sea turtles nest at 2 to 3 year intervals during the months of March to July. Nest building occurs during the night and each turtle will nest up to 11 times per nesting season (USFWS, 2015ae). Current major threats to the species include harvesting turtles and their eggs, hunting, incidental capture in fishing gear, and consumption of plastics that were mistaken for jellyfish (NOAA, 2015h).

Loggerhead Sea Turtle. (*North Pacific Ocean DPS.*) The loggerhead sea turtle is a smaller sea turtle that can grow to an average length of 3 feet and weight of 250 pounds. This species has a reddish-brown carapace and flippers, and is characterized by its large head (USFWS, 2015ae). The loggerhead sea turtle was initially listed as threatened throughout its range in 1978 (43 FR 32800 32811, July 28, 1978), but by 2011 nine different distinct populations were listed and the North Pacific Ocean population was listed as endangered (76 FR 58868 58952, September 22, 2011) (USFWS, 2015ah). In the eastern Pacific Ocean, loggerhead sea turtles have been found from Alaska to Chile. There have been occasional sightings off the coasts of Washington and Oregon and the turtle is known or believed to occur in the waters off of seven counties in Oregon (USFWS, 2016a), but most sightings off the west coast of the U.S. are of juveniles off the coast of California (NOAA, 2014a).

The preferred habitat for the loggerhead sea turtle is the open sea environment, but they also occur in inshore area such as salt marshes, creeks, bays, and lagoons. Open beaches are the

⁸³ Tunicate: “Commonly known as ‘sea squirts.’ The body of an adult tunicate is quite simple, being essentially a sack with two siphons through which water enters and exits. Water is filtered inside the sack-shaped body.” (University of California Museum of Paleontology, 2006)

preferred location for nesting along the coast and coral reefs and rocky places are the preferred feeding areas for the loggerhead sea turtles (NOAA, 2014a). Current threats to the loggerhead sea turtle include incidental captures in fishing gear, directed harvesting of eggs, and loss and degradation of habitats (USFWS, 2008) (NOAA, 2014a).

Olive Ridley Sea Turtle. The olive ridley sea turtle gets its name from its olive colored heart-shaped shell. It is one of the smallest sea turtles, reaching from 2 to 2.5 feet in length and weighing from 80 to 110 pounds. The olive ridley sea turtle can be identified by the high number of bony plates on its shell. The olive ridley sea turtle was federally listed as threatened in 1978 (43 FR 32800 32811, July 28, 1978) (USFWS, 2015ai). It is found in the tropical regions of the Pacific, Atlantic, and Indian Oceans. In the East Pacific, it nests on beaches from Mexico all the way down to Colombia, but during feeding migrations can travel up the U.S. Pacific coast as far north as Oregon (USFWS, 2015ai).

It inhabits tropical and warm temperate ocean waters worldwide, spending most of its time in the open ocean. Every year, it migrates from foraging in the open ocean, to coastal breeding and nesting grounds, back to open ocean foraging. Threats to the olive ridley sea turtle include collection of turtle eggs, killing turtles, incidental captures in fishing gear, marine debris, environmental contamination, and disease. (NOAA, 2014b)

Amphibians

One threatened amphibian species is federally listed for Oregon as summarized in Table 7.1.6-11. Information on the habitat, distribution, and threats to the survival and recovery of this species in Oregon is provided below.

Table 7.1.6-11: Federally Listed Amphibian Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Oregon Spotted Frog	<i>Rana pretiosa</i>	T	Proposed	Wetlands associated with lakes, ponds, or slow moving streams. Found in 6 counties in western Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a T = Threatened

Oregon Spotted Frog. The Oregon spotted frog is a medium-sized frog, growing from 1.7 to 4 inches in body length, and “is the most aquatic native frog in the Pacific Northwest” (USFWS, 2014f). It gets its name from the black spots that cover its head, back, sides, and legs. Juveniles are usually brown in color, but can sometimes be olive green in color on the back, and white or cream colored with reddish pigments under its legs and abdomen. Adults are brown to reddish brown in color, and become redder with age. Red coloring also increases on the abdomen with age, with under the legs becoming a vivid orange-red. This red coloring distinguishes the Oregon spotted frog other native frogs (USFWS, 2014f). The Oregon spotted frog was federally listed as threatened in 2014 (79 FR 51657 51710, August 29, 2014). This species is found in Canada, California, Oregon, and Washington. In Oregon, it can be found in six counties in the western part of the state (USFWS, 2015aj). Critical habitat in Oregon has been designated in 8

units, totaling 534,755 acres, in Deschutes, Jackson, Klamath, Lane and Wasco Counties (81 FR 29336 2939, May 11, 2016).

It inhabits emergent wetlands in or near perennial bodies of water such as springs, ponds, lakes, wetlands, slow-moving streams, irrigation canals, or roadside ditches. It needs areas of shallow water for eggs and tadpoles, and plentiful aquatic vegetation for basking and cover (USFWS, 2014c). Threats to the Oregon spotted frog include habitat loss due to changes in hydrology and water quality, development, and livestock overgrazing; invasion of nonnative plants; succession of plant communities from marsh to meadow habitat; and the introduction of exotic predators such as bullfrogs and nonnative fishes. (USFWS, 2014f)

Invertebrates

Two endangered and two threatened invertebrate species are federally listed for Oregon as summarized in Table 7.1.6-12. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oregon is provided below.

Table 7.1.6-12: Federally Listed Invertebrate Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Fender’s Blue Butterfly	<i>Icaricia icarioides fenderi</i>	E	Yes, 3,010 acres in Benton, Lane, Polk, and Yamhill Counties, Oregon.	Native upland prairie that require natural or human-induced disturbance for their maintenance. Found in the Willamette Valley, in 6 counties in western Oregon.
Oregon Silverspot Butterfly	<i>Speyeria zerene hippolyta</i>	T	Yes, the salt-spray meadow between Big Creek and Rock Creek, Lane County, Oregon.	Three types of grasslands, including coastal terrace and headland “salt spray” meadows, coastal dune systems, and montane grasslands. Found in 5 counties in western Oregon.
Taylor’s Checkerspot	<i>Euphydryas editha taylori</i>	E	Yes, in Benton County, Oregon.	Open grasslands and grass/oak woodland areas where there are available food plants for larvae and nectar sources for adults. Found in the Willamette Valley, in Benton County, western Oregon.
Vernal Pool Fairy Shrimp	<i>Branchinecta lynchi</i>	T	Yes vernal pools in California and Oregon.	Cold water pools in southern Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

Fender’s Blue Butterfly. The Fender’s blue butterfly is a small butterfly with an approximate wingspan of 1 inch. In males, the upper wings are a brilliant blue color with a blackish wing border and a white fringe of scales. In females, the upper wings are brown in color with a white fringe of scales. In both sexes, the undersides of the wings are cream-tan in color with black spots surrounded by a fine, white border (USFWS, 2015ak). The Fender’s blue butterfly was federally listed as endangered in 2000 (65 FR 3875 3890, January 25, 2000) (USFWS, 2015al). Critical habitat was designated in 2006 (71 FR 63862 63977, October 31, 2006) in approximately

3,010 acres in Benton, Lane, Polk, and Yamhill Counties, Oregon (USFWS, 2006a). This species can only be found in six counties in western Oregon (USFWS, 2015al).

It inhabits native upland prairie in the Willamette Valley, most of which require natural or human-induced disturbance for their maintenance. Threats to the Fender's blue butterfly include habitat loss and modification due to agriculture, fire suppression, invasion of nonnative plants, and development. (USFWS, 2015ak)

Oregon Silverspot Butterfly. The Oregon silverspot butterfly is a medium-sized butterfly with an approximate wingspan of 2.2 inches. The upper side of the wings are golden brown in color with many black spots and lines. The undersides of the wings are brown, orange-brown, and tan in color with black lines and silver and black spots. The body and base of the wings are covered in fine hairs. This species can be distinguished from the similar Behren's silverspot and Myrtle's silverspot by its smaller size and northern distribution. The Oregon silverspot butterfly was federally listed as threatened in 1980 (45 FR 44935 44939, July 2, 1980), with critical habitat designated at time of listing in the salt-spray meadow between Big Creek and Rock Creek, Lane County, Oregon. Regionally, this species is found in California and Oregon. In Oregon, it can be found in six counties in the western part of the state. (USFWS, 2011b), (USFWS, 2015am)

It inhabits three types of grasslands, including coastal terrace and headland "salt spray" meadows, coastal dune systems, and montane grasslands. All of these habitats are close to the ocean, have mild temperatures, enough rainfall, and regular fog in the summer. Habitats must also have caterpillar host plants (violets) and adult nectar sources for this species to survive. The greatest threat to the Oregon silverspot butterfly is habitat degradation and destruction due to development, agriculture, invasion of exotic plants, succession of grasslands, off-road vehicles, livestock grazing, and erosion. Other threats may include vehicle collisions, pesticides, collection, and lack of periodic disturbances such as fires. (USFWS, 2011b)

Taylor's Checkerspot. Taylor's checkerspot is "a medium-sized, colorfully-checked butterfly with a wing span of [2.25 inches]. The [upper] surface of the wings are primarily orange with bands of white cells. The [underside] of the wings has a proportionate mix of black, orange, and white... It has short and stubby wings" (USFWS, 2015an). The Taylor's checkerspot was federally listed as endangered in 2013 (78 FR 61451 61503, October 3, 2013), and critical habitat was designated in 2013 (78 FR 61505 61589, October 3, 2013) in Benton County, Oregon (USFWS, 2015ao). This species is found in Washington, Oregon, and British Columbia. Within Oregon, it can be found in the Willamette Valley, Benton County, in the western part of the state (USFWS, 2015ap).

It inhabits open grasslands and grass/oak woodland areas where there are available food plants for larvae and nectar sources for adults. These areas include coastal and inland prairies on post-glacial, gravelly deposits. The main threat to the Taylor's checkerspot is habitat loss due to agricultural and urban development, advancing trees, and the spread of invasive plants. Other threats include pesticide use and recreational activities. (USFWS, 2015an)

Vernal Pool Fairy Shrimp. Vernal pool fairy shrimp (*Branchinecta lynchi*) is a small, freshwater crustacean inhabiting shallow ephemeral (temporary) pools in California, although it

is also believed to occur in Jackson County, Oregon. Adults range in size from 0.12 to 1.5 inches long, with transparent bodies and swim in an inverted position with 11 pairs of swimming legs. Males are distinguished by microscopic characteristics of the second antenna and females carry a pear-shaped (pyriform) brood pouch under their bodies. As with most fairy shrimp, the species remains dormant for long periods in the form of cysts, or “resting eggs.” The cysts hatch when pools fill with winter or spring rains into a short-lived adult phase that feeds and reproduces in the pool, with the population becoming dormant again as the pools become dry again. (USFWS, 2007b)

The species was listed as federally threatened in 1994 (59 FR 48136 48153, September 19, 1994), with critical habitat initially designated in 2003 (68 FR 46684 46687, August 6, 2003), with a final rule published in 2005 (70 FR 46924 46999, August 11, 2005) (USFWS, 2015aq).

Vernal pool fairy shrimp occur in vernal pools, shallow depressions that fill with water in the wet season and are generally dry for the remainder of the year. They are documented in grassy and mud bottomed pools and swales, rock pools in sandstone and basaltic flows, as well as alkaline pools. The species’ range includes several areas in California, with a distinct population in southern Oregon. This is a cold water species, with hatching recorded at 50 °F and die-offs observed at temperatures above 75 °F (USFWS, 2007b).

Threats to the species include loss and degradation of suitable habitat, including vernal pools associated with development, agriculture, alterations to hydrologic systems, and off-highway vehicle activity, among others (USFWS, 1994) (USFWS, 2007b).

Plants

Eleven endangered and nine threatened plant species are federally listed and known to occur in Oregon (Table 7.1.6-13). Northern wormwood (*Artemisia campestris var. wormskioldii*) and whitebark pine (*Pinus albicaulis*) have been identified as candidate species in Oregon, however they will not be discussed further in this section. Further information on the habitat, distribution, and threats to the survival and recovery of each of these species in Oregon is provided below.

Table 7.1.6-13: Federally Listed Plant Species of Oregon

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Applegate’s Milk-vetch	<i>Astragalus applegatei</i>	E	No	Seasonally moist meadows and drainage ditches with native or nonnative bunchgrasses. Found in one county, Klamath County.
Bradshaw’s Desert-parsley	<i>Lomatium bradshawii</i>	E	No	Seasonally saturated or flooded prairies near rivers, streams, and creeks. Found in 5 counties in western Oregon.
Cook’s Lomatium	<i>Lomatium cookii</i>	E	Yes, in 2,282 acres of Jackson County, and 4,007 acres of Josephine County, Oregon.	Seasonally wet soils on upland mounds, at the bottom of vernal pools, and on the sides of vernal pools in rocky or fine-grained soils in the Rogue Valley of Jackson County, and the Illinois Valley of Josephine County, southwestern Oregon.

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Gentner's Fritillary	<i>Fritillaria gentneri</i>	E	No	Found in edge habitat with open woodlands, or open chaparral and grasslands near hardwood forests. Found in Josephine and Jackson Counties in southwestern Oregon.
Golden Paintbrush	<i>Castilleja levisecta</i>	T	No	Upland prairies on generally flat grasslands with glacial outwash. Found in Benton, Linn, Marion, and Polk Counties in western Oregon.
Greene's Tuctoria	<i>Tuctoria greenei</i>	E	Yes, 145,118 acres in Oregon and California.	Vernal pool systems on low and high floodplain terraces. Found in Lake and Klamath Counties.
Hoover's Spurge	<i>Chamaesyce hooveri</i>	T	Yes; 114,713 acres in Oregon and California.	Vernal pool systems within alluvial fans or historical floodplain terraces. Found in Jackson, Josephine, and Klamath Counties.
Howell's Spectacular Thelypody	<i>Thelypodium howellii spectabilis</i>	T	No	Moist alkaline meadow habitats in the Baker-Powder River Valley bottomlands at elevations of approximately 3,000 to 3,500 feet. Found in Baker and Union Counties, northeastern Oregon.
Kincaid's Lupine	<i>Lupinus sulphureus ssp. kincaidii</i>	T	Yes, in Douglas County, Oregon.	Native upland prairie lands dominated by red fescue and/or Idaho fescue. Found in 9 Counties in western Oregon.
Large-flowered Woolly Meadowfoam	<i>Limnanthes floccosa ssp. grandiflora</i>	E	Yes, 5,840 acres in Jackson County, Oregon.	A limited area within the Agate Desert of the Rogue Valley at elevations between 1,200 and 1,310 feet, and is usually associated with vernal pools. Found in the Rogue Valley Plains of Jackson County, southwestern Oregon.
MacFarlane's Four-o'clock	<i>Mirabilis macfarlanei</i>	T	No	Canyon bunch grass grasslands with dry, warm climates and seasonal precipitation. Found in Wallowa County in northeast Oregon.
Malheur Wire-lettuce	<i>Stephanomeria malheurensis</i>	E	Yes, at its location in Harney County, Oregon.	The top of a dry, broad hill on a soil resulting from volcanic tuff that is layered with some limestone. Found in one location near Malheur National Wildlife Refuge in Harney County, southeastern Oregon.
McDonald's Rock-cress	<i>Arabis macdonaldiana</i>	E	No	Dry, open woodlands or brushy slopes with serpentine soils. Found in Curry and Josephine Counties in the Siskiyou Mountains.
Nelson's Checker-mallow	<i>Sidalcea nelsoniana</i>	T	No	Swales and meadows with wet depressions. Found in 11 counties in northwestern Oregon.
Rough Popcornflower	<i>Plagiobothrys hirtus</i>	E	No	Deep, poorly drained soils in alluvial stream terrace depressions. Found in Douglas County in southwestern Oregon.
Slender Orcutt Grass	<i>Orcuttia tenuis</i>	T	Yes, 94,213 acres in Oregon and California.	Vernal pool systems with volcanic substrates with a variety of vegetation communities. Found in Jackson, Josephine, Klamath, and Lake Counties.

Common Name	Scientific Name	Federal Status ^a	Critical Habitat in Oregon	Habitat Description
Spalding's Catchfly	<i>Silene spaldingii</i>	T	No	Open, mesic grasslands or sagebrush-steppe communities. Found in Wallowa County, in the northeastern corner of Oregon.
Water Howellia	<i>Howellia aquatilis</i>	T	No	Wetlands formed by glacial potholes, which consist of wet conditions during winter snowmelt and spring rains and dry conditions by late summer. Found in 6 counties in northwestern Oregon.
Western Lily	<i>Lilium occidentale</i>	E	No	Organic peat soils that are saturated most of the year in coastal prairies, scrub, freshwater fens and bogs, spruce forests, and transition zones. Found in Coos, Curry, and Douglas Counties in Oregon.
Willamette Daisy	<i>Erigeron decumbens</i> var. <i>decumbens</i>	E	Yes, in Benton, Lane, Linn, Marion, and Polk Counties, Oregon.	Both wet prairie grasslands and drier upland prairie sites, where there is almost no woody cover and herbaceous vegetation is short in height. Found in 8 counties in western Oregon.

Sources: (USFWS, 2015c) (USFWS, 2015d)

^a E = Endangered, T = Threatened

Applegate's Milk-vetch. Applegate's milk-vetch (*Astragalus applegatei*) is a perennial herb in the legume family. Stems are slender, clustered, or spreading and are 9.8 to 15.7 in. long. Leaves are compound⁸⁴ with seven to 13 leaflets per leaf and are 0.3 to 0.8 in. long, glabrous⁸⁵ on top and sparsely strigose⁸⁶ beneath. Racemes⁸⁷ may be up to 2.8 in. long with 10 to 18 white to lavender-colored flowers loosely groups and nodding. Flowers have openly notched banners bent at nearly a 90-degree angle upwards. Pods spread horizontally or downward and are narrowly oblong. (ODA, 2015b)

Applegate's milk-vetch was federally listed as endangered in 1993 (58 FR 40547 40551, July 28, 1993). No critical habitat has been designated for this species. Regionally, this species is found in the Lower Klamath Basin of Oregon, in Klamath County. Presently in Oregon, it can be found in three locations in the Lower Klamath Basin all at elevations of 4,100 ft. (USFWS, 1998b).

Habitat for the Applegate's milk-vetch includes meadows and drainage ditches at 4,100 ft. that are seasonally moist and contain alkaline soils. Presently, nonnative grasses and other species often dominate their habitat. Historically, the species was found with native bunch grasses mixed with bare earth. Applegate's milk-vetch is commonly found near rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Ericameria viscidiflora*) (ODA, 2015b)

Bradshaw's Desert-parsley. Bradshaw's desert-parsley, also known as Bradshaw's lomatium, is a perennial herb between 8 and 12 inches tall. Flowers are yellow, small, and grouped into

⁸⁴ Compound – “Divided into a number of similar parts, as the leaflets of compound leaves” (Weber and Wittmann 2012).

⁸⁵ Glabrous – “Completely smooth, without trichomes” (Weber and Wittmann 2012).

⁸⁶ Strigose – Having “straight, stiff, sharp, appressed hairs” (USFS, 2016a).

⁸⁷ Raceme – Clusters of flowers on individual stalks arranged incrementally along a main stem (Nelson, 2012).

asymmetrical umbels.⁸⁸ Blooms appear in April through early May, and the parsley fruits in late May into June. (USFWS, 2015ar) The Bradshaw's desert-parsley was federally listed as endangered in 1988 (53 FR 38448 38451, September 30, 1988). Regionally, this species is found from southwest Washington to the Willamette Valley of Oregon. In Oregon, it can be found in five counties, in the western part of the state (USFWS, 2015as).

The Bradshaw's desert-parsley is found along rivers and seasonally saturated or flooded prairies. Soils in these locations are dense, heavy clays with slow permeability. Threats to this species include habitat degradation and loss due to residential and industrial development, agricultural conversions, and water diversion that has changed the hydrology of preferred habitat environments. (USFWS, 2015ar)

Cook's Lomatium. The Cook's lomatium, or Cook's desert-parsley, is a perennial plant in the parsley family. It grows from six to 20 inches tall and has smooth, bluish-green colored leaves that only grow directly above the root on the ground, not along the stems at all. It has pale yellow flowers that are clustered together in an umbrella-like formation (USFWS, 2015at). The Cook's lomatium was federally listed as endangered in 2002 (67 FR 68004 68015, November 7, 2002) (USFWS, 2015at). This species is only found in the Rogue Valley of Jackson County, and the Illinois Valley of Josephine County, southwestern Oregon. Critical habitat was designated in 2010 (75 FR 42490 42570, July 21, 2010) in 2,282 acres of Jackson County, and 4,007 acres of Josephine County (USFWS, 2012d).

It inhabits seasonally wet soils on upland mounds, at the bottom of vernal pools, and on the sides of vernal pools in rocky or fine-grained soils, in both the Rogue and Illinois valleys. Threats to the Cook's lomatium include off-road vehicle use, mining, road construction, logging in nearby forests, livestock overgrazing, herbivory, invasion of woody plants due to fire suppression, invasion of nonnative grasses and herbs, and herbicides. (USFWS, 2012d)

Gentner's Fritillary. Gentner's fritillary (*Fritillaria gentneri*) is a perennial herb in the lily family. The stem can reach 1.5 ft. tall and has red to purple flowers with yellow streaks. Flowers typically are 1 to 2 in. long and bloom from April to June. Gentner's fritillary reproduces asexually, by breaking off bulbets⁸⁹ that fall to the ground and develop into new plants (USFWS, 2011c).

Gentner's fritillary was federally listed as endangered in 1999 (64 FR 69195 69203, December 10, 1999). No critical habitat has been designated for this species. Regionally, this species is found in the southwest part of Oregon, in Josephine, Klamath, and Jackson Counties. Presently in Oregon, it can be found along the Rogue and Illinois River drainages on federal, state, and privately owned lands (USFWS, 2011c).

Gentner's fritillary is typically found at elevations of 60 to 450 ft. in open woodland edge habitat. The species may also be present in open chaparral and grassland habitat near hardwood forests. Species commonly associated with Gentner's fritillary include Oregon white oak

⁸⁸ Umbels – consists of a number of short flower stalks, which spread from a common point.

⁸⁹ Bulbets – “Asexually reproductive structures derived from flowers or branch primordia, or divisions of a bulb” (Weber and Wittmann 2012).

(*Quercus garryana*), Pacific madrone (*Arbutus menziesii*), white-leaved manzanita (*Arctostaphylos viscida*), poison oak (*Rhus diversiloba*), and ashly rock cress (*Arabis subpinnatifida*) among many other species (USFWS, 2011c).

Golden Paintbrush. The Golden paintbrush is a perennial herb in the figwort or snapdragon family. Several stems erect to “creeping” at the base and give off the appearance of multiple plants. It can grow up to 12 in. tall and is covered in soft, sticky hairs with brilliant yellow flowers. The golden paintbrush was federally listed as threatened in 1997 (62 FR 31740 31748, June 11, 1997). Regionally, this species is found in Oregon and Washington. In Oregon, it can be found in Benton, Linn, Marion, and Polk Counties in the western part of the state. (USFWS, 2015au) (USFWS, 2016g) (USFWS, 2016h)

The Golden paintbrush occurs primarily in upland prairies on generally flat grasslands with glacial outwash. These grasslands are dependent on fire to stem succession, as trees and shrubs overtake grasslands without a fire regime. Threats to this species include habitat loss from agricultural conversion, residential development, and fire suppression. (USFWS, 2015au)

Greene’s Tuctoria. Greene’s tuctoria (*Tuctoria greenei*) is a grass endemic to vernal pools. Stems are pith-filled, and spikelets are in a spiral formation. These grasses do not have distinct leaf sheaths protecting the stem. Tuctoria seeds may be dormant for long periods, and have been documented as viable after five years in dormancy. (USFWS, 2007d)

Greene’s tuctoria was federally listed as endangered in 1997 (62 FR 14338 14352, March 26, 1997). A total of 145,119 acres of critical habitat was designated for this species in 2006 (71 FR 7118 7316, February 10, 2006) (USFWS, 2016b). Regionally, this species is mostly found in California, but has been previously documented in Klamath and Lake Counties, Oregon (USFWS, 2016i).

Habitat for Greene’s tuctoria includes low and high terraces within specific vernal pool systems. Vernal pools that provide habitat include northern basalt flow, northern claypan, and northern hardpan. The species has been documented to grow in shallower pools, or on the periphery or deeper pools, and is not as tolerant of inundation as other grasses found in vernal pools. Vernal pools containing the species have been located in pine forests and grasslands. Threats to Greene’s tuctoria include agriculture development, grazing during flowering season, and competition from invasive weeds. Grasshopper predation may impact some populations. (USFWS, 2007d)

Hoover’s Spurge. Hoover’s spurge (*Chamaesyce hooveri*) is an annual forb and member of the spurge family. Stems lay flat on the ground, forming mats and are gray-green in color. Flowers are grouped into cyathiums, which are small cup structures, averaging 0.08 in. (2 mm.) in diameter. Flowers bloom in July and are red to olive. (USFWS, 2009)

Hoover’s spurge was federally listed as threatened in 1997 (62 FR 14338 14352, March 26, 1997). A total of 114,713 acres of critical habitat was designated for this species in 2006 (71 FR 7118 7316, February 10, 2006). Regionally, this species is mostly found in California, but has been previously documented in Jackson, Josephine, and Klamath Counties, Oregon (USFWS, 2016c).

Hoover's spurge occurs in vernal pools that are relatively large and deep. Vernal pools that provide suitable habitat include northern hardpan and northern claypan within alluvial fans or historical floodplain terraces. Individuals may be located on the periphery of pools or in the deepest parts of the pools once dried. Hoover's spurge is most commonly found in areas where there is less competition from other species. (USFWS, 2009)

Howell's Spectacular Thelypody. The Howell's spectacular thelypody is a biennial herbaceous plant in the mustard family. It grows to approximately 2 ft. tall, and has basal leaves that grow in a rosette at the base of the plant and are 2 in. long with wavy edges. The leaves that grow on the stem are shorter, narrower, and have smooth edges. The flowers have four pink to purple colored petals that are approximately 0.75 in. in length, and each grows on a short stalk in loose spikes at the ends of the stems. The fruits are long, slender pods (USFWS, 2002). The Howell's spectacular thelypody was federally listed as threatened in 1999 (64 FR 28393 28403, May 26, 1999) (USFWS, 2015av).

This species is only found in the Baker-Powder River Valley in Baker and Union Counties, northeastern Oregon. It inhabits moist alkaline meadow habitats in the Baker-Powder River Valley bottomlands at elevations of approximately 3,000 to 3,500 ft. in northeast Oregon. Some populations occur within or next to agricultural fields or urban areas. Threats to the Howell's spectacular thelypody include habitat destruction and fragmentation due to agricultural and urban development, livestock grazing, nonnative species invasion, fire suppression, herbicide and pesticide use, and changes in wetland hydrology. (USFWS, 2002)

Kincaid's Lupine. The Kincaid's lupine is a low growing perennial in the pea or legume family reaching a height of 16 to 30 in. It produces a cluster of yellow-cream colored flowers (USFWS, 2015aw). Kincaid's lupine was federally listed as threatened in 2000 (65 FR 3875 3890, January 25, 2000). Critical habitat was designated in 2006 in Douglas County, Oregon, and Lewis County, Washington (71 FR 63862 6977, October 30, 2006). Kincaid's lupine and has been designated 585 acres of critical habitat (USFWS, 2006b). Regionally, this species is found west of the Cascades in Oregon and Washington. In Oregon, it can be found in nine counties in the western part of the state (USFWS, 2015ax).

Kincaid's lupine is typically found in native upland prairie lands dominated by red fescue and/or Idaho fescue and is part of a fire-dependent ecosystem. The upland prairies are dry, open, grasslands with well-drained soils. Threats to this species include habitat loss from agricultural conversion, urban development and the use of herbicides. (USFWS, 2015aw)

Large-flowered Woolly Meadowfoam. The large-flowered woolly meadowfoam is a delicate annual plant that grows 2 to 6 in. tall, with 2-in. long leaves that are divided into 5 to 9 segments. The stems and leaves have a light covering of short, fuzzy hairs. The flowers, with yellowish to white petals, have a dense covering of woolly hairs. The large-flowered woolly meadowfoam was federally listed as endangered in 2002 (67 FR 68004 68015, November 7, 2002) (USFWS, 2015ay). Critical habitat was designated in 2010 (75 FR 42490 42570, July 21, 2010) including 5,840 acres in Jackson County. This species is only found in the Rogue Valley Plains of Jackson County, southwestern Oregon (USFWS, 2012d).

It inhabits a limited area within the Agate Desert of the Rogue Valley at elevations between 1,200 and 1,310 ft., and is usually associated with vernal pools. It generally grows near the wetter, inner edges of vernal pools, but can also grow on the drier outside edges of the pools, as well as on low upland mounds in some areas. Threats to the large-flowered woolly meadowfoam include road construction, housing, commercial, and industrial development, habitat fragmentation, nonnative grasses and herbs invasion, off-road vehicle damage, dumping, herbicides, livestock grazing, and predation by meadowfoam fly (*Scaptomyza apicalis*) larvae. (USFWS, 2012d)

MacFarlane's Four-o'clock. MacFarlane's four-o'clock (*Mirabilis macfarlanei*) is a perennial herb and is part of the four-o'clock family. Flowers are very bright pink and are about 1 in. long by 1 in. wide, and bloom from May through June. Flowers are funnel-shaped and occur in inflorescences containing three to seven flowers. Leaves are slightly succulent, opposite, and ovate to broadly lanceolate. MacFarlane's four-o'clock reproduces by seed and through an underground, woody tuber that produces daughter plants (USFWS, 2000b).

MacFarlane's four-o'clock was federally listed as endangered in 1979 (44 FR 61912 61913, October 26, 1979) and reclassified as threatened in 1996 (61 FR 10693 10697, March 15, 1996). No critical habitat has been designated for this species. Regionally, this species is found in northeast Oregon and northwest Idaho, and has been previously documented in Wallowa County, OR (USFWS, 2016d). Specifically, 11 populations are present total in Idaho and Oregon, and in Oregon, it is found in the river canyons of the Snake, Salmon, and Imnaha Rivers (USFWS, 2000b).

MacFarlane's four-o'clock is typically found on gravelly to loamy and sandy soils in canyon grasslands between 1,000 and 3,000 ft. Habitat is present in warm and dry areas with some precipitation during winter and spring. Plants are commonly found on southeast to western slopes that are steep to flat. Grasslands that provide habitat consist of bunchgrasses with dominants such as bluebunch wheatgrass (*Agropyron spicatum*). Threats to MacFarlane's four-o'clock include grazing pressures, competition from nonnative plant species, human trampling, off-road vehicles, road and trail construction, and herbicide and pesticide use (USFWS, 2000b).

Malheur Wire-lettuce. The Malheur wire-lettuce is an annual plant with leaves forming a rosette at its base and a many-branched single stem that has scale-like leaves. The flowers are clustered 5 to 11 per head, and are pink, white, or sometimes orange-yellow in color (USFWS 1991). The Malheur wire-lettuce was federally listed as endangered in 1982 (47 FR 50881 50886, November 10, 1982) with critical habitat designated at time of listing at its location in Harney County (USFWS, 1991), (USFWS, 2015az).

This species can only be found in one location near Malheur National Wildlife Refuge (NWR) in Harney County, southeastern Oregon. It inhabits the top of a dry, broad hill on a soil resulting from volcanic tuff that is layered with some limestone. Threats to the Malheur Wire-lettuce include mining, competition with nonnative plants, herbivory, and its small population size. (USFWS, 1991)

McDonald's Rock-cress. McDonald's rock-cress (*Arabis macdonaldiana*) is a perennial herb part of the mustard family. Stems are abundant and lay flat on the ground, forming mats. Leaves form basal rosettes, averaging 0.4 to 0.8 in. long and 0.1 to 0.3 in. wide and sometimes are toothed on the edges. Cauline leaves are narrow, oblong, and 0.1 to 0.4 in. long. Flowers have crimson to purple petals that are 3.1 to 4.1 in. long that are on simple racemes. Greenish to dark purple sepals are present at the base of the flower. Flowers bloom from May to June (ODA, 2015c).

McDonald's rock-cress was federally listed as endangered in 1978 (43 FR 44810 44811, September 28, 1978). No critical habitat has been designated for this species. Regionally, this species is found in southwest Oregon, and has been previously documented in Curry and Josephine Counties, Oregon (USFWS, 2016j) (USFWS, 2016k). Specifically, in Oregon, the current populations are all located in the Siskiyou Mountains (ODA, 2015c).

Habitat for McDonald's rock-cress includes dry, open woodlands or brushy slopes with serpentine soils under 5,900 ft. in elevation (ODA, 2015c). Woodlands associated with the species typically contain ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*), sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), and occasionally knobcone pine (*Pinus attenuata*) (USFWS, 1984). Other associated species may include violets species (*Viola spp.*), hoary manzanita (*Arctostaphylos canescens*), huckleberry oak (*Quercus vaccinifolia*), and dwarf ceanothus (*Ceanothus pumilus*). Threats to the species include mining, road maintenance and development, and over-collection (ODA, 2015c).

Nelson's Checker-mallow. Nelson's checker-mallow is a perennial herb growing from 1.3 to 4.2 ft. Flowering stems are moderately branched with tall lavender to deep pink flowers. Nelson's checker-mallow was federally listed as threatened in 1993 (58 FR 8235 8243, February 12, 1993) (USFWS, 1993). Nelson's checker-mallow can be found from Oregon north to Washington. In Oregon, it is found in 11 counties in the northwestern part of the state. (USDA, 2011) (USFWS, 2016l)

Its preferred habitat includes wetland prairie and emergent herbaceous wetlands. It can be found in swales and meadows with wet depressions, or along streams containing seasonally wet soils. Threats to this species include habitat loss and degradation from agricultural conversion, urban development, stream alteration, and fire suppression. (WNHP, 2011)

Rough Popcornflower. The rough popcornflower is an annual herb in the borage family. It grows from 2.7 to 23.6 in. tall, and has narrow, hairy leaves that grow along hairy stems. The trumpet-shaped flowers are mostly white with yellow centers, and have five petals. Each flower produces four tan to black-colored nutlets. The rough popcorn flower was federally listed as endangered in 2000 (65 FR 3866 3875, January 25, 2000). (USFWS, 2015ba)

This species can only be found in the Umpqua River drainage in Douglas County, southwestern Oregon. It inhabits swales or season wet meadows, and stays submerged under standing water from late fall through spring. It mostly grows on deep, poorly drained soils that are found in depressions in alluvial stream terraces. Threats to the rough popcornflower include urban and

agricultural development, invasion of nonnative species, and habitat fragmentation and degradation. (USFWS, 2003)

Slender Orcutt Grass. Slender orcutt grass (*Orcuttia tenuis*) is a grass in the Poaceae family. The species grows as individual stems or in small tufts that can grow 2 to 7.9 in. Branching from the main stem occurs on the upper half of the stem and plants tend to have few hairs. Leaves at the base are 0.06 to 0.08 in. wide. The species has a large inflorescence, that makes up half of the plant's overall height, and contains several spikelets (USFWS, 2010c).

Slender orcutt grass was federally listed as threatened in 1997 (62 FR 14338 14352, March 26, 1997). A total of 94,213 acres of critical habitat was designated for this species in 2006 (71 FR 7118 7316, February 10, 2006) (USFWS, 2006c). This species is believed to occur in Jackson, Josephine, Klamath, and Lake Counties in Oregon (USFWS, 2016e).

Habitat for slender orcutt grass includes vernal pools with volcanic substrates and other natural and manmade wetland systems. Vernal pools that the species typically grows on include northern volcanic ashflow and northern volcanic mudflow. Populations have been found between 27 and 5,761 ft. The species can be found with a variety of vegetation communities, from oak woodlands, grasslands, and mixed conifer forests. Threats to the species include urbanization and destruction of habitat, off-road vehicle use, and nonnative species competition (USFWS, 2006c).

Spalding's Catchfly. The Spaulding's catchfly is a perennial⁹⁰ herbaceous plant of the carnation family that can grow up to 30 inches in height and flowers from July to August. The species was federally listed as threatened in 2001 (66 FR 51597 51606, October 10, 2001). This plant gets its name because it is "covered in dense sticky hairs that frequently trap dust or insects" (USFWS, 2007c). Its range includes Idaho, Montana, Oregon, and Washington. In Oregon, the species can be found in Wallowa County, in the northeastern corner of the state (USFWS, 2015bb).

Suitable habitat for this species includes "open, mesic⁹¹ grasslands or sagebrush-steppe communities" within valleys and along drainages, and occasionally open pine forests. This species often occurs in a fire-dependent ecosystem. Typically, this species is associated with rough (*Festuca scabrella*) and Idaho (*Festuca idahoensis*) fescues, Nelson's (*Stipa nelsonii*) and Richard's (*Achnatherum richardsonii*) needlegrasses, and bluebunch wheatgrass (*Pseudoroegneria spicata*). Threats to this species include competition with nonnative invasive plants, fire suppression, small population sizes, livestock grazing and trampling, land conversion, climate change, insect damage, disease, and off-road vehicle use. (USFWS, 2007c)

Water Howellia. The water howellia is an aquatic, winter annual ranging from 4 to 24 in. in height that flowers in May to August. It was federally listed as threatened in 1994 (59 FR 35860 35864, July 14, 1994). Regionally, this species is found in California, Idaho, Montana, Oregon, and Washington. In Oregon, it can be found in six counties in the northwestern part of the state. (USFWS, 2015bc)

⁹⁰ Perennial plants: "Plants that live for more than two growing seasons. Perennial plants either die back after each season (herbaceous plants) or grow continuously (shrubs)." (USEPA, 2015s)

⁹¹ Mesic: "Soil condition that is medium-wet." (USEPA, 2015s)

Suitable habitat for this species consists of wetlands formed by glacial potholes with a varied hydrologic regime,⁹² consisting of wet conditions during winter snowmelt and spring rains, and dry conditions by late summer (USFWS, 2015bc). This plant is typically submerged or floating in water (USFWS, 1996). Important wetland habitat is often surrounded by deciduous⁹³ forest. The primary threats to this species and its habitat include timber harvesting, livestock grazing, invasion of nonnative invasive plants, and human-induced habitat conversion from increased urbanization, agriculture, and flood control measures (USFWS, 1996).

Western Lily. Western lily (*Lilium occidentale*) is a perennial herb in the lily family. The species stem is slender, and grows to be 24 to 67 in. Leaves are narrowly oblanceolate, scattered, but whorled in the center of the plant, dark green in color, and are on average 2 to 9 in. long and 0.2 to 1 in. wide. Flowers are showy and conspicuous, with the distal portions being crimson red and the basal portions being orange, yellow, or greenish yellow. Two forms of the species exist depending on soil characteristics and correlate with being located in California versus Oregon (ODA, 2015d).

Western lily was federally listed as threatened in 1994 (59 FR 42171 42176, August 17, 1994). No critical habitat has been designated for this species. Historically, this species was found in Coos, Curry, and Douglas Counties in Oregon. The range spans a 200 mile-wide band along the Pacific coastline of Oregon in mentioned counties (ODA, 2015d).

Western lily is found in two distinct soil types. In Oregon, it occurs in a deep organic peat that is saturated for the majority of the year. The species can be found near the ocean in coastal prairie and scrub areas, freshwater fens and on the periphery of bogs, and in transition zones. It may also be found in spruce forests, but will not produce flowers. Threats to the species include habitat removal and degradation from agriculture and urbanization, road construction, deer herbivory, over-collection, hydrological alteration, genetic variability loss, and fungal, viral, or bacterial infections (ODA, 2015d).

Willamette Daisy. The Willamette daisy is a perennial herb that grows as single plants or as clumps of identical clones. It blooms white flowers in June and early July and produces seeds in late summer, which are distributed by the wind (USFWS, 2010b). The Willamette daisy was federally listed as endangered in 2000 (65 FR 3875 3890, January 25, 2000) (USFWS, 2015bd). Critical habitat was designated in 2006 (71 FR 63862 63977, October 31, 2006) in Benton, Lane, Linn, Marion, and Polk Counties. These counties contain 718 acres of occupied critical habitat. (USFWS, 2010b) (USFWS, 2013g)

This species can only be found in eight counties in western Oregon (USFWS, 2015bd). It inhabits both wet prairie grasslands and drier upland prairie sites, where there is almost no woody cover, and herbaceous vegetation is short. Threats to the Willamette daisy include habitat loss due to urban and agricultural development, successional intrusion into its habitat by trees and shrubs, competition with nonnative weeds, and its small population sizes (USFWS, 2010b).

⁹² Hydrologic regime: “The system that describes the occurrence, distribution, and circulation of water on the earth and between the atmosphere.” (USEPA, 2015s)

⁹³ Deciduous: “Plants having structures that are shed at regular intervals or at a given stage in development, such as trees that shed their leaves seasonally.” (USEPA, 2015s)

7.1.7. Land Use, Recreation, and Airspace

7.1.7.1. Definition of the Resources

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

Land Use and Recreation

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

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, caves, lakes, forests, beaches, recreational facilities, museums, historic sites, and other areas/facilities. Recreational resources are typically managed by federal, state, county, or local governments.

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

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 composed 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, 2015c). The FAA works with state aviation officials and airport planners, military airspace managers, and other organizations in deciding how best to use airspace.

7.1.7.2. Specific Regulatory Considerations

Appendix C, Environmental Laws and Regulations, summarizes numerous federal environmental laws and regulations that, to one degree or another, may affect land use in Oregon. However, local county and city laws and regulations govern most site-specific land use controls and requirements. Furthermore, many land use controls and requirements are implemented and enforced under the umbrella of land use planning, often with the help and support of state authorities. The Oregon Department of Land Conservation and Development's Statewide Planning Goals and Guidelines are the current state level guidance for land use planning in Oregon (Oregon Department of Land Conservation and Development, 2010).

Because federal laws govern the Nation's airspace, there are no specific Oregon state laws that would alter the existing conditions relating to airspace for this PEIS. The Oregon Laws, Volume 17, Title 62 Aviation, Chapters 835-838, address aviation for the state (Oregon Laws, 2013c).

7.1.7.3. Land Use and Ownership

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

Land Use

Table 7.1.7-1 and Figure 7.1.7-1 identify the major land uses by coverage type in Oregon. Forest and woodlands comprise the largest portion of land use with 44.9 percent of Oregon's total land area occupied by this category. Semi-desert land accounts for 28.3 percent, and shrubland and grassland 6.3 percent. Agricultural land accounts for 8.6 percent and developed areas account for approximately 2.3 percent of the total land area. The remaining percentage of land includes public land, surface water, and other land covers, shown in Figure 7.1.7-1, that are not associated with specific land uses (USGS, 2011).

Table 7.1.7-1: Major Land Use in Oregon by Coverage Type

Land Use	Square Miles	Percent of Land
Forest and Woodland	43,138	44.9%
Semi-Desert	27,175	28.3%
Agricultural Land	8,221	8.6%
Shrubland and Grassland	6,013	6.3%
Developed Land	2,219	2.3%
Other	9,222	9.6%

Sources: (USGS, 2011)

Forest and Woodland

The largest land use in Oregon is forest and woodland areas, which are throughout the state and total approximately 43,138 square miles of land (USGS, 2011). The largest concentrations of this land use are in the western third of the state and from central to the northeast region of the state. The federal government (i.e., USFS and BLM), owns 59 percent of the forest and woodland areas in Oregon (approximately 25,450 square miles). Most of the federally owned forests are at high elevations and contain older growth forests (USFS, 2008). Section 7.1.6 presents additional information about terrestrial vegetation.

State Forests

State Forests account for 1,193 square miles of Oregon land, among six designated State Forest and several other smaller parcels of land. The Oregon Department of Forestry manages these lands. State Forests are classified into four management categories: high value conservation areas (14 percent), special use areas (9 percent), focused stewardship (59 percent), and general stewardship (18 percent). The categories define the management approach, ranging from conservation and protection of old growth trees and habitat to management for a variety of uses. (ODF, 2015a)

Private Forest and Woodland

Approximately 17 percent of Oregon’s forestland is privately held by families and non-commercial owners. Approximately 92 percent of private owners hold parcels fewer than 500 acres. Private owners often use their forest and woodland parcels as part of the primary residence (USFS, 2008). For additional information regarding forest and woodland areas, see Section 7.1.6, Biological Resources, and Section 7.1.8, Visual Resources.

Semi-Desert

Land use within the semi-desert category in Oregon includes wildlife management areas, wilderness and wilderness study areas, recreation, wild horse range and management areas, minerals development and livestock grazing (BLM, 2016a) (BLM, 2016b). The majority of semi-desert areas occur within the southeastern portion of the state (Figure 7.1.7-1) and are managed by the BLM (Figure 7.1.7-2) (USGS, 2011).

Agricultural Land

As shown in Table 7.1.7-1, about 8.6 percent of Oregon’s total land area is classified as agricultural land (8,221 square miles) (USGS, 2011), most of which concentrated in the western and northern part of the state (Figure 7.1.7-1). In 2015, there were 34,600 farms in Oregon, with the average farm size of 474 acres (USDA, 2016). Major agricultural production in Oregon includes hay, wheat, potatoes, hazelnuts, pears, grapes, berries, hazelnuts, and dairy. Other agricultural uses are livestock for dairy and meat, aquaculture, and cut Christmas trees (USDA, 2016). The USDA Census of Agriculture website provides additional county-level agriculture information for the state:

(www.agcensus.usda.gov/Publications/2012/Full_Report/Census_by_State/Oregon/).

Shrubland and Grassland

The largest concentrations of shrubland and grassland are located in the northeast and south areas of the state (Figure 7.1.7-1). Land use in these areas varies by location and includes both private and public land ownership (Figure 7.1.7-2). Some of the uses within this category include ranching, recreation, and wildlife preservation. (USGS, 2011)

Developed Land

Developed land in Oregon is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs (Figure 7.1.7-1). Although only 2.3 percent (2,219 square miles) of Oregon land is categorized as developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 7.1.7-2 lists the top five developed metropolitan areas within the state and their associated population estimates, and Figure 7.1.7-1 shows where these areas are located within the developed land use category. (USGS, 2011)

Table 7.1.7-2: Top Five Developed Metropolitan Areas in Oregon (2014 estimate)

Metropolitan Area	Population Estimate
Portland (OR/WA)	1,490,336
Eugene	247,421
Salem	236,632
Medford	154,081
Bend	83,794
Total Population of Top 5 Metropolitan Areas	2,212,264
Total State Population	3,970,239

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

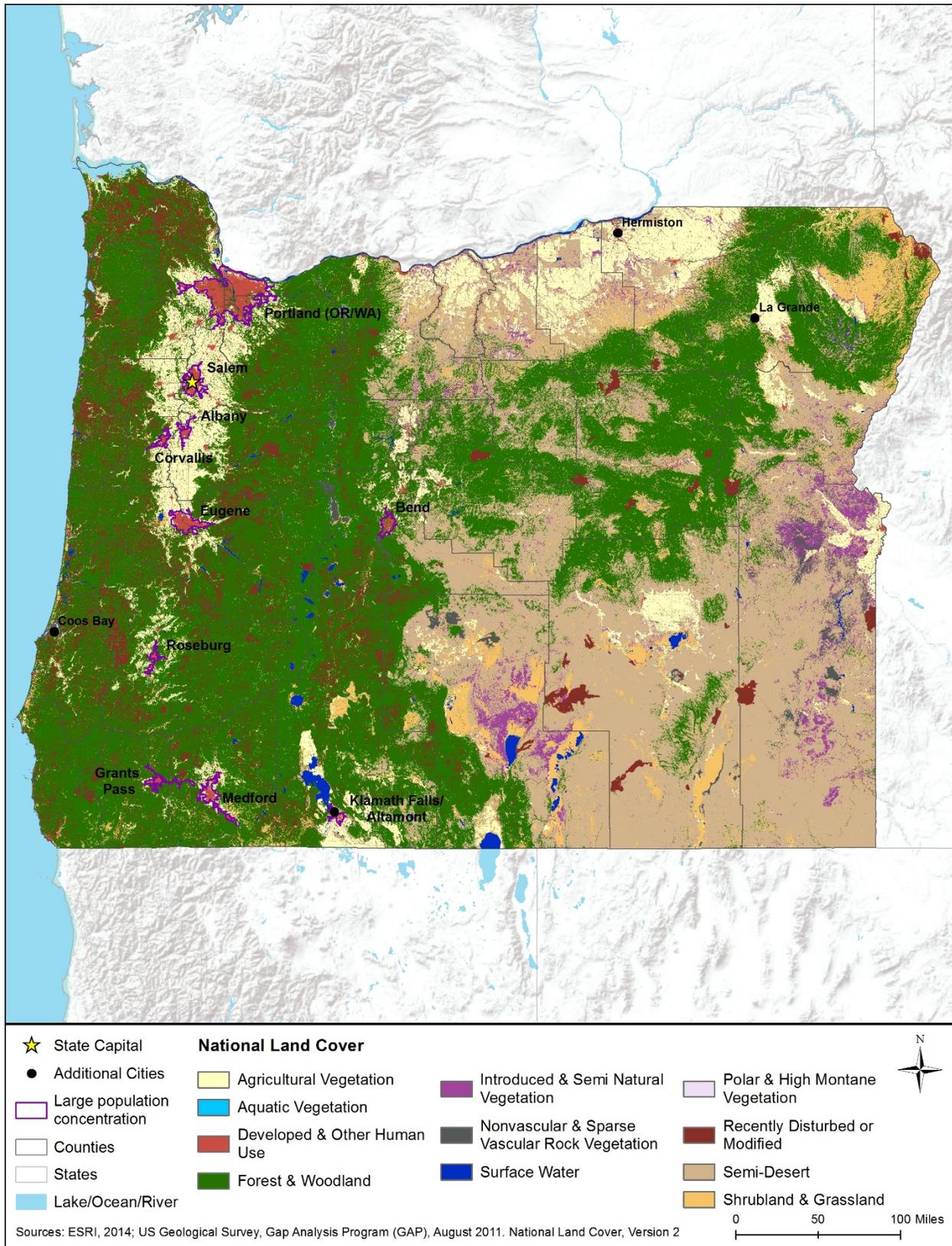


Figure 7.1.7-1: Major Land Use Distribution by Coverage Type

7.1.7.4. Land Ownership

Land ownership within Oregon has been classified into four main categories: private, federal, state, and tribal (Figure 7.1.7-2).⁹⁴

Private Land

Approximately 40 percent of land in Oregon is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Table 7.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. Private land exists in all regions of the state.⁹⁵

Federal Land

The federal government manages 51,767 square miles (53 percent) of Oregon land with a variety of land types and uses, including military bases, national wildlife refuges (NWRs), national grassland and forests, national parks and monuments, irrigation projects, dams, and wilderness areas (USGS, 2012d) (USGS, 2014g). Six federal agencies manage the majority of federal lands throughout the state (Table 7.1.7-3 and Figure 7.1.7-2). There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state.⁹⁶

Table 7.1.7-3: Federal Land in Oregon

Agency	Square Miles	Representative Type
Department of Defense (DoD)	191	Military facilities, training centers, and chemical depot, U.S. Army Corps of Engineers (USACE) recreation areas and facilities
U.S. Fish and Wildlife Service (USFWS)	939	NWRs
U.S. Forest Service (USFS)	25,622	National Scenic Area, National Grassland, National Forests
National Park Service (NPS)	308	National Park, National Historic Site, National Monuments, National Historical Parks
Bureau of Reclamation	67	Irrigation projects, hydropower plants, and dams
Bureau of Land Management (BLM)	24,640	Wilderness, National Monument, Outstanding Natural Area
Total	51,767	NA

Sources: (USGS, 2012d) (USGS, 2003b)

NA = Not applicable

⁹⁴ 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 United States by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset, which 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.

⁹⁵ Total acreage of private land could not be obtained for the state.

⁹⁶ Not all federal agency land is depicted in Figure 7.1.7-2 given the small size of some of the land acreage.

Uses of Federal Lands in Oregon (Table 7.1.7-3) include:

- DoD facilities, training centers, and a chemical depots, such as Klamath Falls Airport-Kingsley Field (ANG), Naval Weapons Systems Training Facility Boardman, NG Bend Cotef, NG Biak Training Center, NOSC Portland, Portland IAP, and Umatilla Chem Depo (DoD, 2014);
- Eleven USACE recreation areas, recreation facilities, and campgrounds across the state (Recreation.gov, 2016);
- Twenty-one National Wildlife Refuges managed by USFWS (USFWS, 2016f);
- USFS-managed property including the Columbia River Gorge National Scenic Area, the Crooked River National Grassland, and 11 National Forests (USFS, 2016b);
- One National Park, a National Historic Site, two National Monuments, and two National Historical Parks(NPS, 2015a) ;
- Water and irrigation projects, hydropower plants, and dams operated by Bureau of Reclamation (Bureau of Reclamation, 2015a); and
- BLM managed lands consisting of the Cascade-Siskiyou National Monument, Steens Mountain Cooperative Management and Protection Area, Yaquina Head Outstanding Natural Area, forestland, and rangeland (BLM, 2015a).

State Land⁹⁷

The Oregon state government owns approximately 2,624 square miles of land composed of state trust lands, forest and woodlands, state forests, fish and wildlife habitats, and state parks. Two state agencies, the Oregon Department of State Lands (ODSL) and Oregon Department of Forestry (ODF) manage the majority of state lands (Table 7.1.7-4 and Figure 7.1.7-2). (USGS, 2012d) (USGS, 2014g)

Table 7.1.7-4: State Land in Oregon

Agency	Square Miles ^a	Type
Oregon Department of State Lands (ODSL)	1,021	State Trust Lands
Oregon Department of Forestry (ODF)	1,193	Forest and woodlands, State Forests
Oregon Department of Fish and Wildlife (ODFW)	246	Fish and wildlife habitat, fish hatcheries
Oregon State Parks and Recreation	164	State Parks

Source: (USGS, 2014g)

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

Uses of state lands in Oregon (Table 7.1.7-4) include:

- State trust land and natural resources by ODSL to generate funds for the public school fund (ODSL, 2015b);
- Six ODF-managed state forests to provide economic, social, and environmental benefits (ODF, 2015b);
- Fish and wildlife habitat, hunting, fishing, recreation opportunities, and fish hatcheries managed by ODFW (ODFW, 2015e); and
- Nearly 200 State parks (Oregon State Parks, 2016).

⁹⁷ State land use data for tables and narrative text were derived from specific state sources and may not correspond directly with USGS data that was used for developing maps and figures.

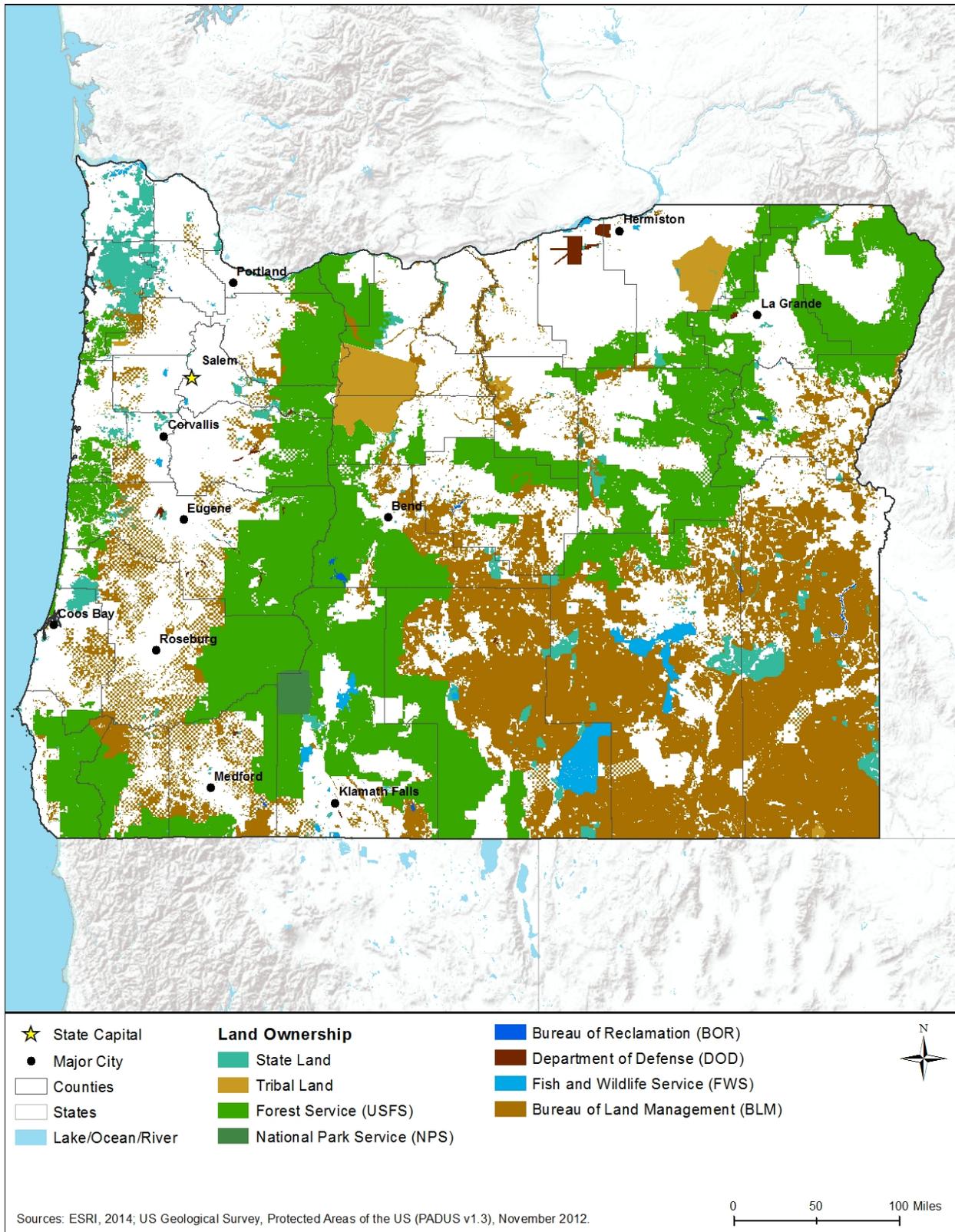


Figure 7.1.7-2: Land Ownership Distribution

Tribal Land

The Bureau of Indian Affairs, along with individual tribes, manages 1,559.9 square miles, or 1.6 percent of the total land area currently located in Oregon.⁹⁸ These lands are composed of 12 Indian Reservations located throughout the state (Table 7.1.7-5 and Figure 7.1.7-2). For additional information regarding tribal land, see Section 7.1.11 Cultural Resources.

Table 7.1.7-5: Indian Reservations and Other Land Holdings in Oregon

Reservation Name	Square Miles
Coos, Lower Umpqua, and Siuslaw Reservation	<0.1
Celilo Village	0.2
Cow Creek Reservation	1.0
Klamath Reservation	1.1
The Dalles Unit	1.3
Siletz Reservation	5.9
Coquille Tribe of Oregon	10.4
Grand Ronde Reservation	16.5
Burns Paiute Reservation	19.0
Fort McDermitt Reservation	28.6
Umatilla Reservation	458.6
Warm Springs Reservation	1,017.3
Total	1,559.9

Sources: (USGS, 2012e) (USGS, 2014g)

7.1.7.5. Recreation

Oregon is a state with diverse geography, including mountains, desert dunes, and volcanoes. Mountain ranges and several wild and scenic rivers in the state heavily influence recreation in the state. On the community level, towns, cities, and counties provide range of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, and lake, river, or beach access points. Availability of community-level facilities is typically commensurate to the population’s needs. Figure 7.1.7-3 displays natural areas that may be visually sensitive, including park and recreation areas.⁹⁹

This section discusses recreational opportunities available at various locations throughout Oregon. For information on visual resources, see Section 7.1.8, Visual Resources, and for information on the historical significance of locations, see Section 7.1.11, Cultural Resources.

⁹⁸ 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.

⁹⁹ The natural areas data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (<http://gapanalysis.usgs.gov/padus/>). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive dataset, which 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 the District of Columbia.

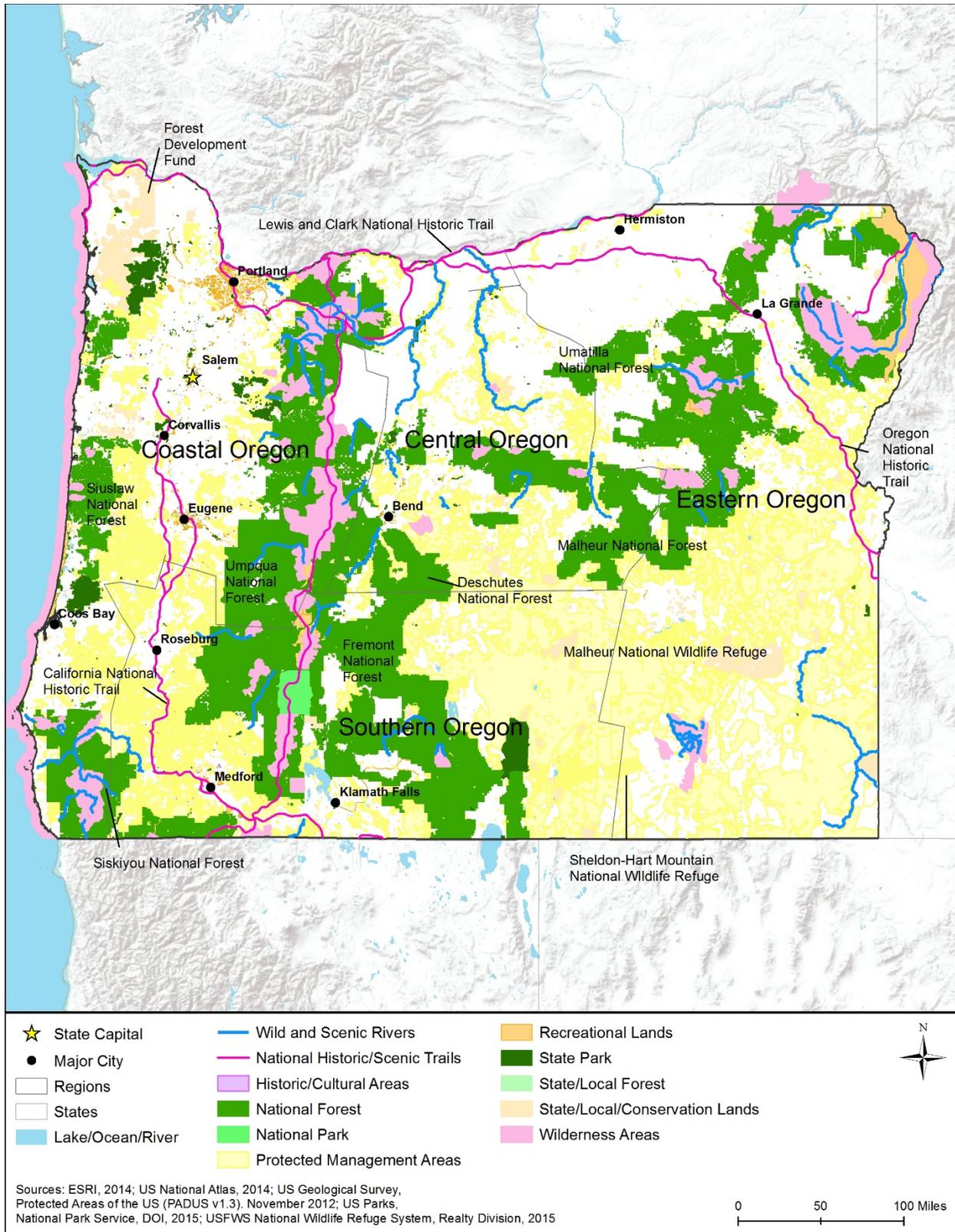


Figure 7.1.7-3: Oregon Recreation Resources

Coastal Region

Oregon's Coastal Region consists of the strip of land on the state's western side, bordered to the west by the Pacific Ocean, the Columbia River to the north, and California to the south (see Figure 7.1.7-3). Numerous state parks, viewpoints, recreation areas, and natural sites line the Oregon coastline. Beaches are popular for beachcombing, swimming, fishing, surfing, and other activities, with public access to the beaches guaranteed by state law. The Oregon Coast Trail reaches 382 miles along the coastline, popular for hiking, horseback riding, and wildlife viewing. (OPRD, 2015a)

The Siuslaw National Forest consists of forests and coastal mountains, and includes places such as the Sand Lake Recreational Area, Marys Peak Scenic Botanical Area, and the Oregon Dunes National Recreation Area, known for dune buggy riding. Other activities include hiking, horseback riding, mountain biking, and other trail use; camping and picnicking; boating, surfing, tubing, waterskiing, and other water activities; and seasonal, licensed hunting. (USFS, 2015a)

The Rogue River-Siskiyou National Forest stretches between the Cascades Mountains and the Siskiyou Mountains, and includes the Rogue River Trail, a 40-mile trail along the Rogue National Wild and Scenic River. Recreational activities within the forest include hiking, horseback riding, mountain biking, and other trail use; camping, picnicking, fossil collecting, and rockhounding;¹⁰⁰ beachcombing, dog sledding, and other beach activities; boating, surfing, tubing, waterskiing, and other water activities; and seasonal, licensed hunting. (USFS, 2015b)

Greater Portland and Willamette Valley

Greater Portland and the Willamette Valley lie to the south of the Columbia River, with the Willamette River cutting through the center of the region (see Figure 7.1.7-3). Portland is known for neighborhoods that celebrate the arts, with artisan coffee, breweries, wineries, craft- and hand-made furniture stores. The city is often referred to as a walking city, often hosting events and festivals celebrating the local culture. (Travel Oregon, 2015a)

The Willamette Valley's 700 vineyards, historic towns, and covered bridges are tourist attractions (Travel Oregon, 2015b). The City of Eugene and local community artists encourage tourists through the Public Art Program, which displays art in parks, government buildings, and other public places, and offers walking tours of the city (City of Eugene Oregon, 2015). The Willamette National Forest, in the Calapooya Mountains, includes the Opal Creek Scenic Recreation Area, with venues for hiking, horseback riding, bicycling, camping, picnicking, boating, swimming, and seasonal licensed hunting. (USFS, 2015c)

The region also included the Molalla River State Park at the confluence of the Molalla, Willamette, and Pudding Rivers. Recreational activities at Molalla River State Park include hiking, picnicking, boating, and fishing. (OPRD, 2015b)

¹⁰⁰ Rockhounding: "Collecting of rocks, mineral specimens, gemstones, petrified wood and common invertebrate fossils on public lands managed by the BLM." (BLM 2014c)

Southern Region

The Southern Region is south of the Willamette Valley and the Ochoco National Forest, and bordered to the south by California (see Figure 7.1.7-3). This region is known for its many vineyards and culinary artisans, as well as rugged outdoor recreation (Travel Oregon, 2015c).

Crater Lake National Park contains the deepest lake in the United States; it is known for its clear, blue color and surrounding cliffs. Summer activities in the park include hiking, swimming, boat and trolley tours, fishing, and camping. Winter activities include cross-country skiing and snowshoe hiking. (NPS, 2015b) The Oregon Caves National Monument and Preserve, located in the Siskiyou Mountains, has torus of the marble caves and hiking trails (NPS, 2015c).

The Umpqua National Forest, in the western Cascade Mountains, is known for its waterfalls and white-water rafting. The Fremont-Winema National Forest is known for the Pacific Crest National Scenic Trail and other hiking trails. Activities within the forests include hiking, horseback riding, bicycling, rockhounding, camping, picnicking, beachcombing, dogsledding, sand and dune activities, boating, swimming, and seasonal, licensed hunting. (USFS, 2015d) (USFS, 2015e)

Central Region

The Central Region lies east of the Cascade Mountains, characterized as high desert (see Figure 7.1.7-3). This region has venues for skiing, fishing, mountain climbing, hiking, biking, and white-water rafting. (Travel Oregon, 2015d)

The Deschutes National Forest contains the Newberry National Volcanic Monument and the Lava River Cave Interpretive Site, both areas within the Lava Lands with lakes, lava flows, and other features. The Ochoco National Forest and Crooked River National Grassland are known for rolling hills and steep overlooks, popular for prairie wildflower viewing. Activities within the forests include hiking, horseback riding, bicycling, rockhounding, camping, picnicking, beachcombing, dog sledding, sand and dune activities, boating, swimming, skijoring, downhill skiing, sledding, cross-country skiing, and seasonal, licensed hunting. (USFS, 2015f) (USFS, 2015g)

BLM recreation areas in the region are forests, mountains, and high desert. The Christmas Valley Sand Dunes are the largest shifting sand dune system in Oregon, the Crack-in-the-Ground is a volcanic fissure, and Lake Albert is the state's only saltwater lake. Hang-gliding, white-water rafting, hiking, mountain biking, camping, and hunting areas are available. (BLM, 2015b)

Mt. Hood/The Gorge

Mt. Hood, an active volcano and the highest point in the state, and the Columbia River Gorge, a canyon of the Columbia River, offer recreational activities that include rock climbing, downhill skiing, windsurfing, sailing, parasailing, and hang-gliding (see Figure 7.1.7-3) (Travel Oregon, 2015e).

Mt. Hood National Forest includes the Timothy Lake Recreation Area, the Clackamas Wild and Scenic River, and the Mt. Hood Meadows Ski Resort. Recreation within the forest is year-round,

with hiking, horseback riding, bicycling, camping, picnicking, boating, swimming, skijoring, downhill skiing, sledding, cross-country skiing, and seasonal, licensed hunting. (USFS, 2015h)

Eastern Region

The Eastern Region is bordered on the east by Idaho, the north by Washington, and the south by Nevada (see Figure 7.1.7-3). The region includes the Wallowa Mountains, popular for horseback riding, hiking, and camping. The region is a tourist draw with historic towns and ghost towns. (Travel Oregon, 2015f)

The Malheur National Forest, in the Blue Mountains of eastern Oregon, includes a Wild and Scenic River and several wilderness areas. Recreation in the forest is influenced by alpine lakes and meadows within the forest. Activities include hiking, horseback riding, bicycling, rockhounding, camping, picnicking, boating, swimming, downhill skiing, sledding, cross-country skiing, and seasonal, licensed hunting. (USFS, 2015i) The Malheur River corridor is popular for camping, hunting, and hiking; the river also has a significant recreational trout fishery (National Wild and Scenic Rivers System, 2015b).

7.1.7.6. 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.

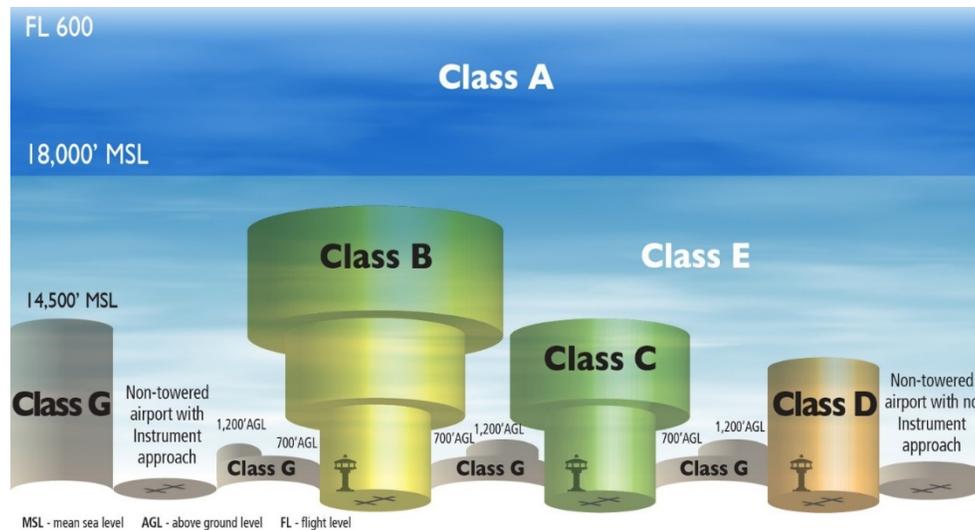
Airspace Categories

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 7.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)¹⁰¹ service is based on the airspace classification (FAA, 2008).

¹⁰¹ ATC – Approved authority service to provide safe, orderly and expeditious flow of air traffic operations. (FAA, 2015d)



Source: Derived from (FAA, 2008)

Figure 7.1.7-4: National Air Space Classification Profile

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL)¹⁰². Includes the airspace over waters off the U.S. coastlines (48 contiguous States and Alaska) within 12 Nautical Miles (NM). All operations must be conducted under Instrument Flight Rules (IFR).¹⁰³
- **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).

¹⁰² 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)

¹⁰³ IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015d).

Uncontrolled Airspace

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

Special Use Airspace

SUA designates specific airspace that confines or imposes limitations on aircraft activities (See Table 7.1.7-6).

Table 7.1.7-6: SUA Designations

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

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

Other Airspace Areas

Other airspace areas, explained in Table 7.1.7-7, include Airport Advisory, Military Training Routes (MTRs), Temporary Flight Restrictions (TFRs), Parachute Jump Aircraft Operations, published Visual Flight Rules (VFR) and IFRs, and Terminal Radar Service Areas.

Table 7.1.7-7: Other Airspace Designations

Type	Definition
Airport Advisory	<p>There are three types:</p> <ul style="list-style-type: none"> • 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	<p>TFRs are established to:</p> <ul style="list-style-type: none"> • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the state of Hawaii declared national disasters for humanitarian reasons. <p>Only those TFRs annotated with an ending date and time of “permanent” are included in this 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.</p>
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

7.1.7.7. Aerial System Considerations

Unmanned Aerial Systems

Unmanned Aerial Systems (UASs) are widely used by the military, private entities, public service, educational institutions, federal/state/local governments, and other agencies. The FAA’s Unmanned Aircraft Systems Integration Office integrates UAS into the NAS. The *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap of 2013* addresses the actions and considerations needed to integrate UAS into the NAS “without reducing existing capacity, decreasing safety, negatively impacting current operators, or

increasing the risk to airspace users or persons and property on the ground any more than the integration of comparable new and novel technologies” (FAA, 2013).

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

Balloons

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

7.1.7.8. Obstructions to Airspace Considerations

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

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

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.

7.1.7.9. Oregon Airspace

The Oregon Department of Aviation (ODA) is a state agency that reports to the Oregon Aviation Board. The state Airports and Program Divisions of the ODA are responsible for engineering and planning of the state’s aviation system. The broad mission of the ODA is to “serve and advocate for the economic growth, infrastructure improvement, and safe operation of aviation in Oregon” (Oregon Department of Aviation, 2015a). More specifically, the Program Division is responsible for “State and Federal grant program management; Aviation planning, engineering, and land use; Tall structure and code compliance planning; Contracting and Procurement and ODA Capital Improvement Projects” (Oregon Department of Aviation, 2015b). There is one FAA FSDO for Oregon located in Portland (FAA, 2015c).

“The Oregon Aviation Plan 2007 (OAP 2007)¹⁰⁴ assesses 97 public-use airports, which include 85 publicly-owned and 12 privately owned airports stretched out over 98,386 square miles of the state of Oregon...” (Oregon Department of Aviation, 2008). The OAP 2007 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 (NASAO), 2015). Figure 7.1.7-5 presents the different aviation airports/facilities in Oregon, while Figure 7.1.7-6 and Figure 7.1.7-7 presents the breakout by public and private airports/facilities. There are approximately 420 airports within Oregon as presented in Table 7.1.7-8 and Figure 7.1.7-6 and Figure 7.1.7-7 (FAA, 2016).

Table 7.1.7-8: Type and Number of Oregon Airports/Facilities

Type of Airport or Facility	Public	Private
Airport	95	228
Heliport	1	93
Seaplane	1	1
Ultralight	0	0
Balloonport	0	0
Gliderport	0	1
Total	97	323

¹⁰⁴ Also known as the Oregon State Aviation System Plan (SASP), the OPA 2007 categorizes the state’s public airport as Category I – Commercial Service Airports, Category II – Urban General Aviation Airports, Category III – Regional General Aviation Airports, Category IV – Local General Aviation Airports, or Category V – RAES (Remote Access/Emergency Service) Airports.

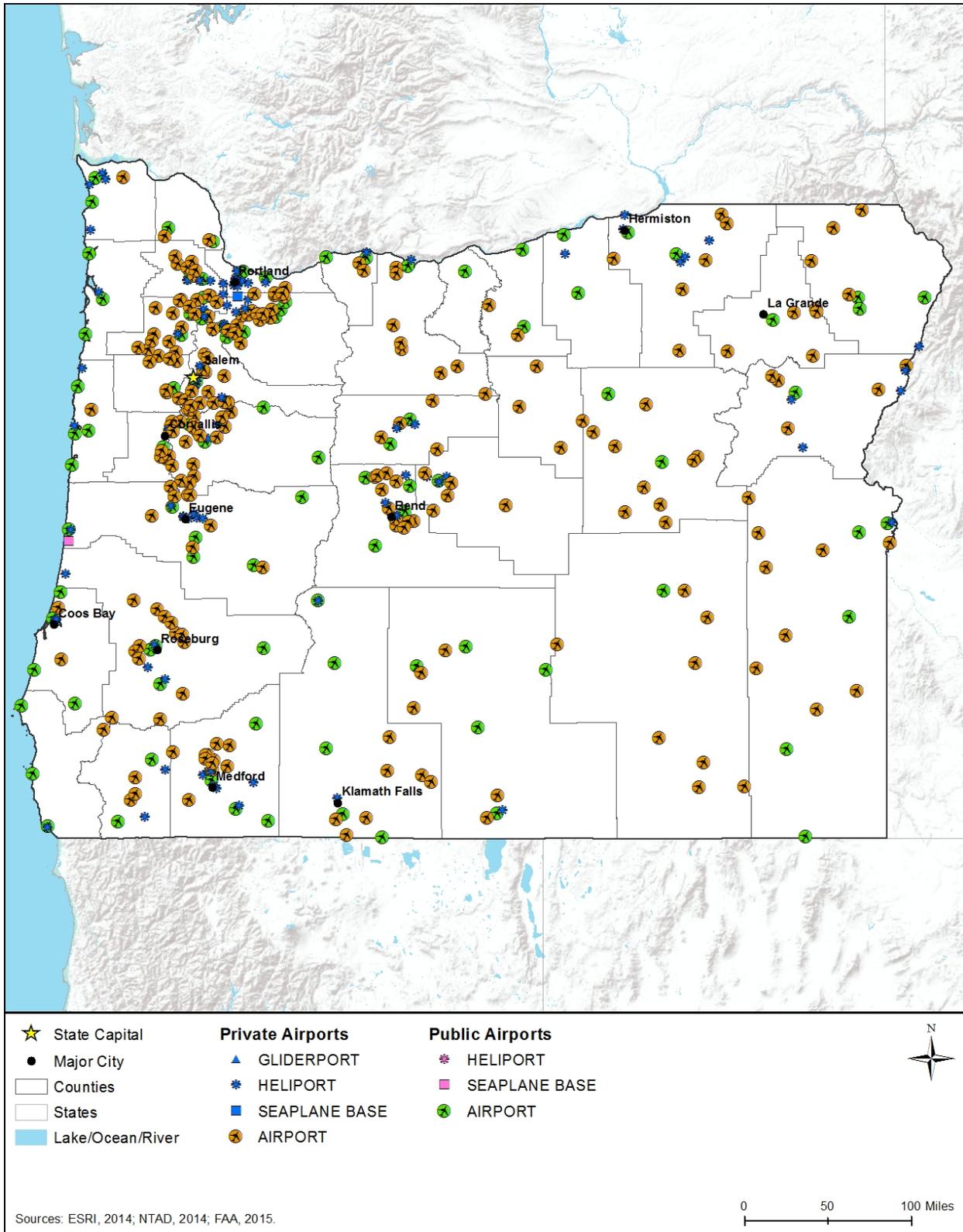


Figure 7.1.7-5: Composite of Oregon Airports/Facilities

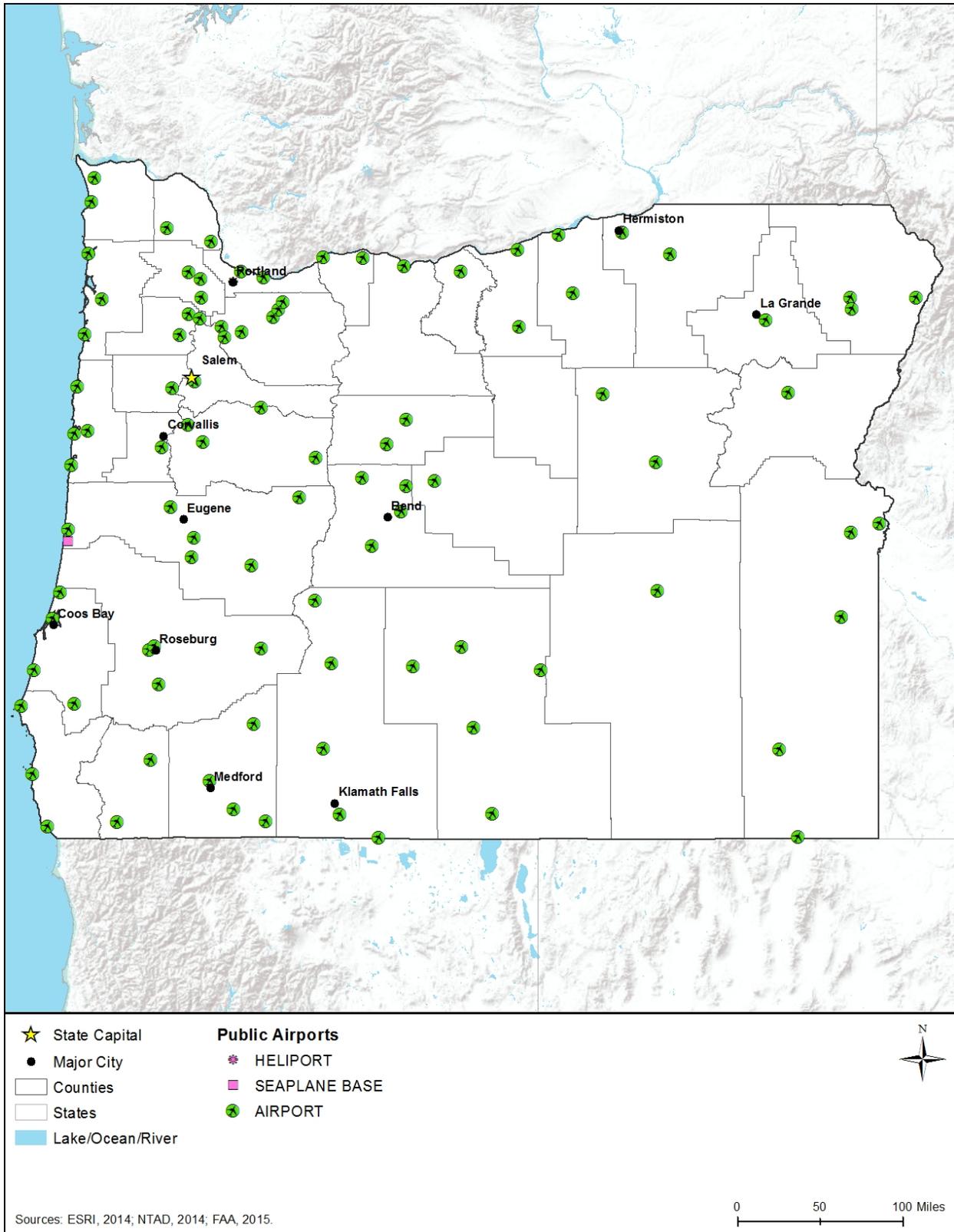


Figure 7.1.7-6: Public Oregon Airports/Facilities

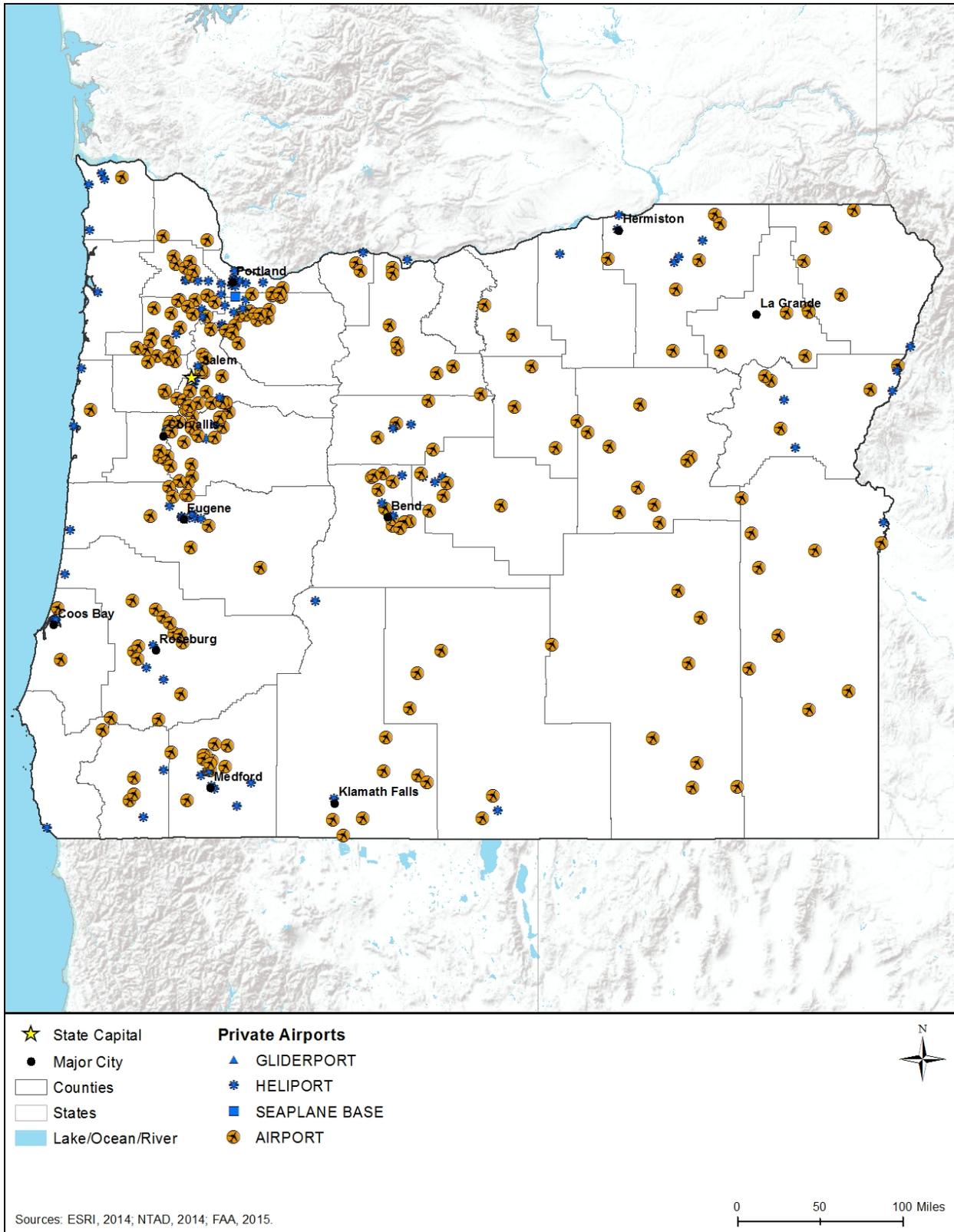


Figure 7.1.7-7: Private Oregon Airports/Facilities

Class C and Class D controlled airports are as follows:

- One Class C –
 - Portland International
- Nine Class D –
 - Mahlon Sweet Field, Eugene
 - Klamath Falls
 - Rogue Valley International-Medford Airport, Medford
 - Southwest Oregon Regional, North Bend
 - Pendleton Municipal
 - Portland-Hillsboro
 - Portland-Troutdale
 - Redmond, Roberts Field, Redmond
 - McNary Field, Salem (FAA, 2015f)

SUAs (i.e., two restricted areas, and 13 MOAs) located in Oregon are as follows:

- Boardman (Restricted)
 - R-5701A to E – A five NM radius circle centered at lat. 45°43'35"N., long. 119°41'07"W., surface to FL 200; within two NM north and three NM south of the 082° bearing from the center of the circle extending to a line one NM west of and parallel to Butter Creek, surface to 10,000 feet MSL to a distance of seven NM from the center of the circle, thence surface to 6,000 feet MSL to the east extremity; within three NM either side of the 234° bearing from the center of the circle extending to ten NM from the center, excluding the airspace within V-112, surface to 10,000 feet MSL to a distance of 7 NM from the center of the circle, thence surface to 6,000 feet MSL to the south west extremity; within three NM either side of the 270° bearing from the center of the circle extending to fifteen NM from the center, surface to 10,000 ft. MSL to a distance of seven NM from the center of the circle, thence surface to 6,000 feet MSL to the west extremity.
 - R-5706 – 3,500 feet MSL to 10,000 feet MSL (FAA, 2015g)

The thirteen MOAs for Oregon are as follows:

- Boardman –
 - 4,000 feet MSL to, but not including, FL 180
- Dolphin –
 - North – 11,000 feet MSL to, but not including. FL 180
 - South – 11,000 feet MSL to, but not including. FL 180
- Goose –
 - North – 3000 feet AGL to, but not including, FL 180
 - South – 10,000 feet MSL to but not including FL 180 (not lower than 3000 AGL)
- Hart –
 - North – 11,000 feet MSL to, but not including, FL 180
 - South – 11,000 feet MSL to, but not including, FL 180
- Juniper –
 - Low – 300 feet AGL to, but not including, 11,000 feet MSL; Excluding the airspace 1,500 feet AGL and below within a three NM radius of the center of the Alkali Lake State and Wagon Tire Airports, Oregon
 - North – 11,000 feet MSL to, but not including, FL 180

- South – 11,000 feet MSL to, but not including, FL 180
- Paradise –
 - North – 3,000 feet AGL or 10,000 feet MSL whichever is higher, to 17,999 feet MSL
- Saddle –
 - A – 10,000 feet MSL to, but not including, FL 180
 - B – 8,000 feet MSL to, but not including, FL 180 (FAA, 2015g)

The SUAs for Oregon are presented in Figure 7.1.7-8. There are no TFRs (Figure 7.1.7-8) (FAA, 2015h). There is a National Security Area (NSA 0006)¹⁰⁵ located around Hermiston (Figure 7.1.7-8) (FAA, 2015g; U.S. Navy, 2015). The restrictions associated with this NSA, when active, may impact the airspace in the area. MTRs in Oregon, presented in Figure 7.1.7-9, consist of 15 Visual Routes, 12 Instrument Routes, and two Slow Routes.

UAS Considerations

The NPS signed a policy memorandum on June 24, 2014 that “directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service” (NPS, 2014d). There are six National Park Service Units in Oregon, including parks, historic sites, national monuments, and national historic parks, that must comply with this agency directive. (NPS, 2015a).

Obstructions to Airspace Considerations

Several references in the Oregon Revised Statutes address airspace hazards. As defined in the Oregon Revised Statutes, Chapter 836 – Airports and Landing Fields, an aviation hazard is “any structure, object of natural growth, or use of land, that obstructs the airspace required for the flight of aircraft in landing or taking off at an airport, or is otherwise hazardous to such landing or taking off.” (Oregon Laws, 2013a) Additionally, Chapter 836.535 provides “(1) A person may not construct an object or structure that constitutes a physical hazard to air navigation, as determined by the Oregon Department of Aviation in coordination with the governing body with land use jurisdiction over the property. (2) Subsection (1) of this section does not apply: (a) To construction of an object or structure that is utilized by a commercial mobile radio service provider; or (b) If a person received approval or submitted an application for approval from the Federal Aviation Administration or the Energy Facility Siting Council established under ORS 469.450 to construct an object or structure that constitutes a physical hazard to air navigation (Oregon Laws, 2013b).”

¹⁰⁵ National Security Area (NSA) consists of defined vertical and lateral dimensions in the airspace where there is increased security of ground facilities. Pilots are expected to voluntarily avoid flying through the NSA. Additional security levels may result in further restrictions of the NSA, which FAA Headquarters would issue and disseminate with a NOTAM. (FHWA, 2014b)

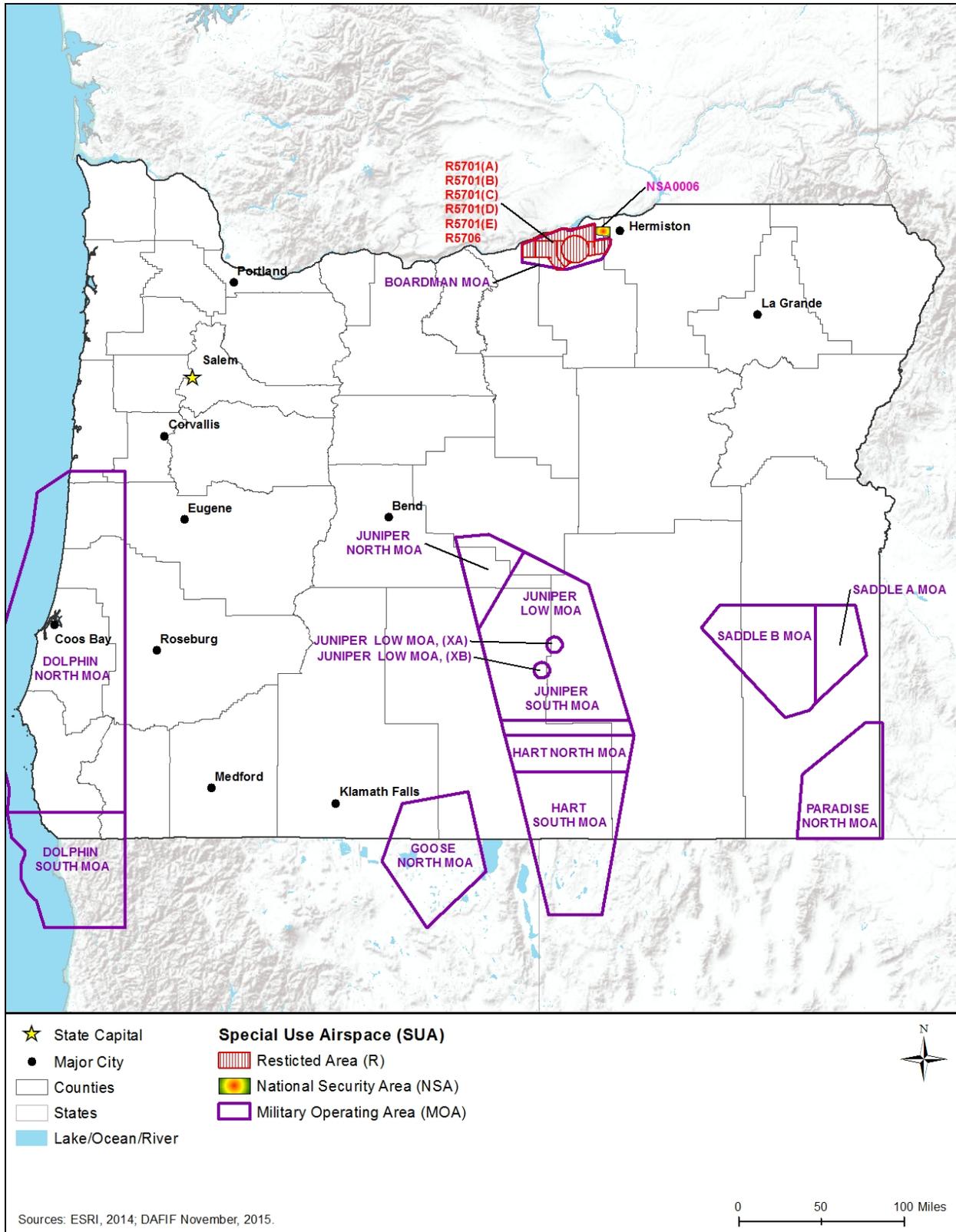


Figure 7.1.7-8: SUAs in Oregon

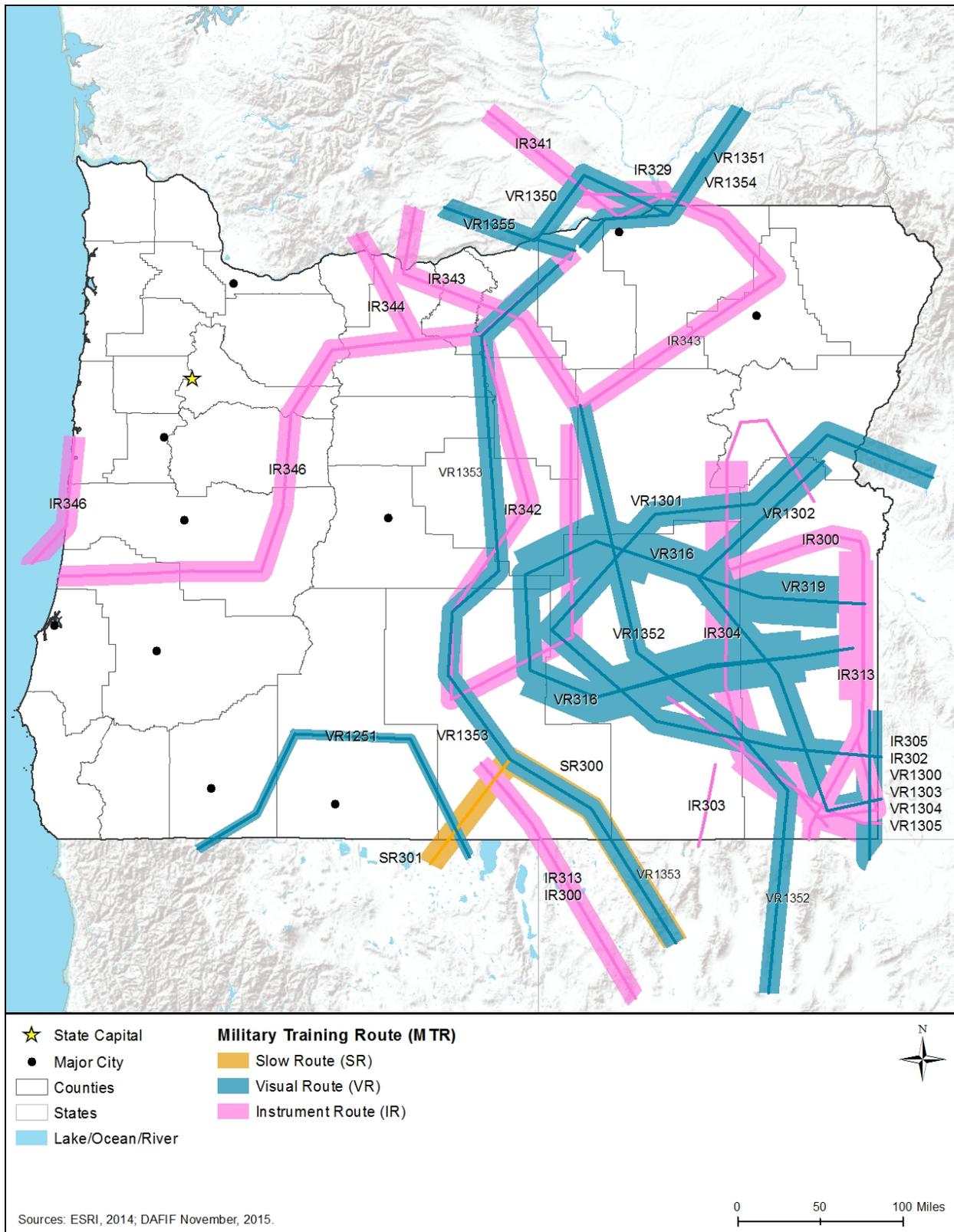


Figure 7.1.7-9: MTRs in Oregon

7.1.8. Visual Resources

7.1.8.1. 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, whereas others prefer natural areas. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating Proposed Actions for NEPA and NHPA compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management, “the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)” (BLM, 1984).

7.1.8.2. Specific Regulatory Considerations

Table 7.1.8-1 presents state and local laws and regulations that relate to visual resources.

Table 7.1.8-1: Relevant Oregon Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Oregon Administrative Rule (OAR) 734-032-0000 – 0070	Oregon Transportation Commission/Oregon Tourism Commission	Establishes the state’s Scenic Byway Program to: “create a comprehensive statewide multi-agency program to identify and manage Oregon’s most outstanding scenic transportation corridors; preserve and/or enhance Oregon’s most outstanding scenic transportation corridors; and provide meaningful tourism opportunities for the traveling public.”
OAR 736-040-0005 (State Scenic Waterways)	Oregon Parks and Recreation Department (OPRD)	Gives OPRD the authority to administer the state Scenic Waterways “to protect and enhance the values” of the identified scenic waterway with primary emphasis on “scenic beauty” among others.
OAR 736-045-0006 Oregon Natural Areas Program	OPRD	Establishes a Natural Areas Advisory Committee to develop Natural Areas policy and plans and to determine criteria for inclusion in the state’s natural heritage register.
OAR 736-009-0006 Oregon Recreation Trails	OPRD	Establishes Oregon Scenic Trails program for “routes that provide access to national, state, or regional resources of superlative quality and scenic splendor.”
OAR 736-018-0000 State Park Master Planning.	OPRD	Establishes process for master plan of state parks, which “identify and provide for protection of important natural, cultural, and scenic resources within state parks.”

In addition to state laws and regulations, Oregon “State Goal 5, Open Spaces, Scenic and Historic Areas, and Natural Resources, requires jurisdictions to conserve open space and protect natural and scenic resource” via administrative rule, ensuing that development planning takes into account protection of visual resources (Bureau of Planning - Portland, Oregon, 1991).

7.1.8.3. Character and Visual Quality of the Existing Landscape

Oregon's landscape is diverse with a rugged Pacific Coastline, assorted mountain ranges, dense forests, and many lakes. Oregon's principal mountain ranges include: Coastal Range in the northwest, Klamath Mountains in the southwest, the Cascades run north to south along the midwestern portion of the state, while the Blue Mountains and Wallowa Mountains rise in the northeast and the Basin and Range (Steens Mountains) from the southeast (Oregon Department of Geology and Mineral Industries, 2016). Oregon has the deepest lake in the United States, Crater Lake at 1,932 feet (USGS, 2016b), and the deepest gorge, Hell's Canyon, at nearly 8,000 feet (National Wild and Scenic Rivers System, 2016).

As shown in Figure 7.1.7-1, forestlands (45 percent) and semi-desert (28 percent) comprise the two most prevalent visual resource types in Oregon. Oregon's forestlands are noted for "ponderosa pine [*(Pinus ponderosa)*], juniper [(Genus *Juniperus*)], and white fir [*(Abies concolor)*] forests [that] are intermixed with grasslands and shrubsteppe" (BLM, 2016c). Semi-desert areas of Oregon are generally composed of sagegrass/bunchgrass and sub-alpine vegetation (BLM, 2016a).

One aspect of importance for visual resources is to maintain the character of the area. For example, in a farm community, keeping the character of the town consistent with farm-style houses, barns, and silos would be key in maintaining the character of the community. In a more metropolitan area, there may be many different visual styles within each neighborhood, but keeping the character of the neighborhood is important to maintain if new development were to occur.

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.

7.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 7.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Oregon, there are 1,985 NRHP listed sites, which include 17 National Historic Landmarks, (NHLs) 2 National Historical Parks, 3 National Historic Trails, 1 National Historic Site (NPS, 2015a), and 1 National Scenic Trail (USFS, 2016c). Some State Historic Sites and State Historic Districts may also be included in the NRHP, whereas others are not designated at this time.

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

National Historic Landmarks

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, 2015d). NHLs may include “historic buildings, sites, structures, objects, and districts” (NPS, 2014h). 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 Oregon, there are 17 NHLs, including sites such as Bonneville Dam Historic District, Fort Astoria Site, Oregon Caves Chateau, Sunken Village Archaeological Site, and Aubrey Watzek House (see Figure 7.1.8-1) (NPS, 2015f). By comparison, there are over 2,500 NHLs in the United States, with less than 1 percent of these located in Oregon (NPS, 2015e). Figure 7.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Historic Sites

Oregon has one National Historic Site, which is preserved by the NPS to “commemorate persons, events, and activities important in the nation’s history” (NPS, 2003). The National Historic Site in Oregon is the Fort Vancouver Historic Site. This site represents the center of “fur trade and military history in the Pacific Northwest” (NPS, 2016). “Fort Vancouver National Monument was established on June 19, 1948 ‘to preserve as a national monument the site of the original Hudson’s Bay stockade (of Fort Vancouver) and sufficient surrounding land to preserve the historical features of the area’ for ‘the benefit of the people of the United States.’” The location of the above is identified on the map in Figure 7.1.8-1.

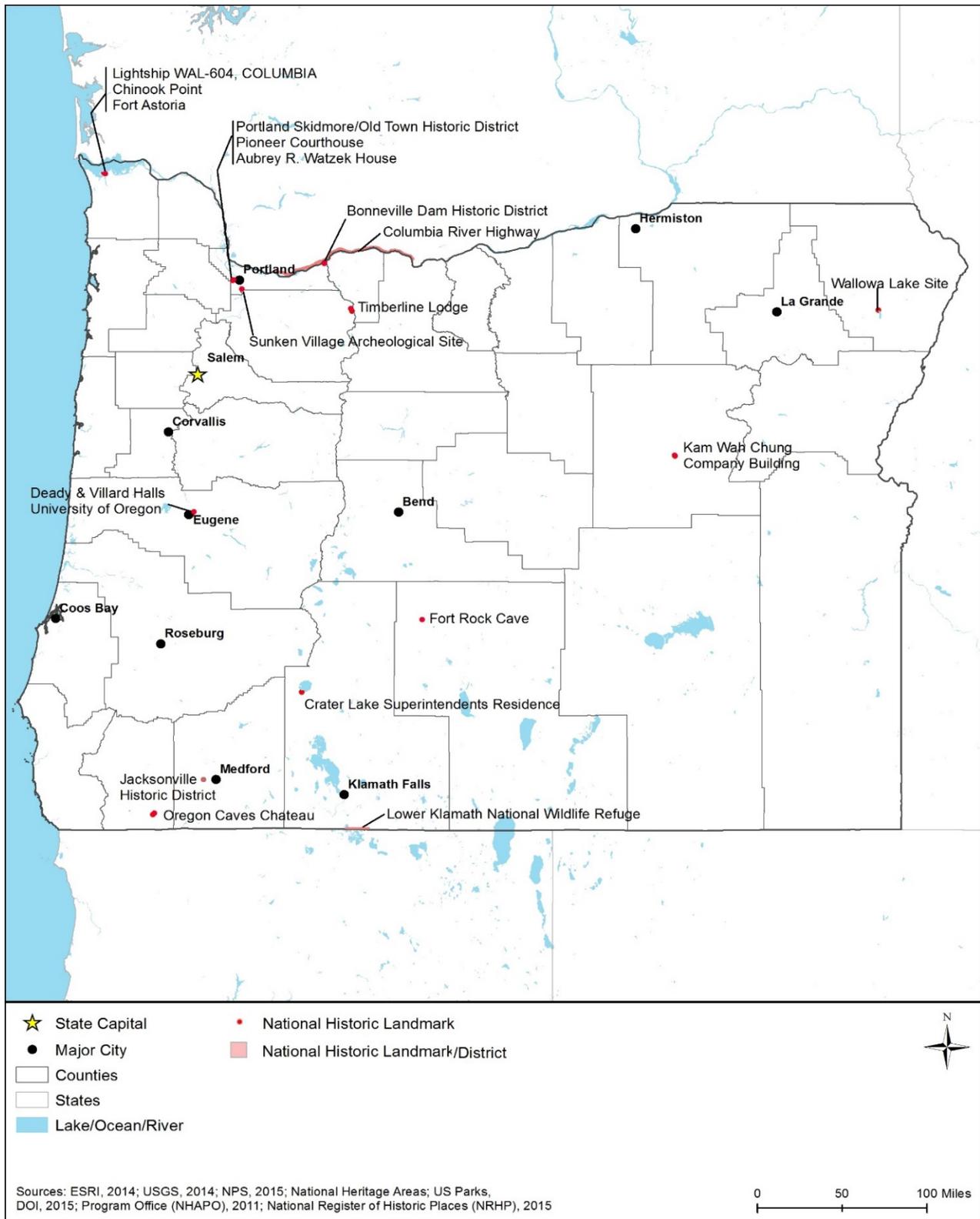


Figure 7.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

National and State Historic Trails

The National Trails System Act defines National Historic Trails as “extended trails which follow as closely as possible and practicable the original trails or routes of travel of national historic significance” (NPS, 2012a). The NPS manages three National Historic Trails that pass through Oregon and surrounding states (see Figure 7.1.8-3): California National Historic Trail (1,000 miles), Lewis and Clark National Historic Trail (3,700 miles), and Oregon National Historic Trail. The Oregon National Historic Trail covers more than 2,000 miles across six states, tracing the path of early American settlers headed to Oregon. (NPS, 2015a) Additionally, the USFS manages the Nez Perce National Historic Trail, which covers 1,170 miles from Oregon to Montana along the route of the Nez Perce people fleeing from their homeland to Canada (USDA, 2015b).

Oregon also designates state historic trails. The Oregon Parks and Recreation Department (OPRD) administers 16 state historic trails as delineated in Table 7.1.8-2. Visual resources on these trails include forests, rocks, wildflowers, creeks, Columbia River overlooks, historic sites, farmland, mountains, sagebrush, timber and ranchlands, and waterfowl (Oregon Historic Trails Fund, 2012). See Figure 7.1.8-3 for a sample of these trails displayed on a map.

Table 7.1.8-2: Oregon State Historic Trails

Trail Name	
Lewis and Clark National Historic Trail*	Cutoff to the Barlow Road
Oregon National Historic Trail*	Klamath Trail
California (Applegate) National Historic Trail*	Jedediah Smith Route
Nez Perce (Nee-Me-Poo) National Historic Trail*	Nathaniel Wyeth Route
Whitman Mission Route	Benjamin Bonneville Route
Upper Columbia River Route	Ewing Young Route
Meek Cutoff	John Fremont Route
Free Emigrant Road	Santiam Wagon Road

Source: (Oregon Historic Trails Fund, 2012)

*Also designated National Historic Trails.

National Historical Parks

Oregon has two National Historical Parks, which are preserved by the NPS to “commemorate persons, events, and activities important in the nation’s history” (NPS, 2003). The national historical parks in Oregon are Lewis and Clark National Historical Park and Nez Perce National Historical Park (NPS, 2015a). These sites may contain aesthetic and scenic values associated with history. Locations of the above are identified on the map in Figure 7.1.8-1.

State Historic Sites and Parks

The Oregon State Historic Preservation Office (SHPO) administers state programs for the protection of state historic and cultural resources including state historic sites. The SHPO assists parties with ensuring Oregon’s historic resources are registered in the state register and National Register of Historic Places but does not administer state historic sites. The Oregon Department

of Parks and Recreation administers historic sites when they are contained within the state’s park system (OPRD, 2015c). Many of these historic sites may contain aesthetic and scenic values associated with history.

State Heritage Areas

Oregon’s Parks and Recreation Department maintains 13 state heritage areas and/or sites as part of the parks system as delineated in Table 7.1.8-3 and displayed on Figure 7.1.8-3 (OPRD, 2015c). An example of a state heritage area is Emigrant Springs State Heritage Area where pioneers stopped on the Oregon Trail (OPRD, 2015d). Visual resources within this area include old growth forests and rustic cabins (OPRD, 2015d). For additional information on state heritage areas, see Section 7.1.12, Cultural Resources, and Oregon’s State Parks website.

Table 7.1.8-3: Oregon State Heritage Areas and Sites

Heritage Area Name	
Champoeg State Heritage Area	Kam Wah Chung State Heritage Site
Emigrant Springs State Heritage Area	Pete French Round Barn Heritage Site
Fort Yamhill State Heritage Area	Sumpter Valley Dredge State Heritage Area
Frenchglen Hotel State Heritage Site	Thompson’s Mills State Heritage Site
Geisel Monument State Heritage Site	Willamette Stone State Heritage Site
Golden State Heritage Site	Wolf Creek Inn State Heritage Site
Iwetemlaykin State Heritage Site	

Source: (OPRD, 2015c)

7.1.8.5. Parks and Recreation Areas

Parks and recreation areas include National Parks, National Forests, National Monuments, BLM, USFS, or other public lands; state parks, forests, or trails; and other protected areas used for recreational activities. Public lands under federal ownership are subject to NEPA, and visual and aesthetic resources are considered in their NEPA analysis. Public lands, parks, and recreation areas often contain scenic resources and are visited because of their associated visual or aesthetic qualities. Figure 7.1.7-3 in Section 7.1.7, Land Use, Recreation, and Airspace, identifies parks and recreational resources in Oregon. Figure 7.1.8-3 displays natural areas that may be visually sensitive, including park and recreation areas.

National Park Service

National Parks, owned and managed by the NPS, contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public’s use. In Oregon, there are six¹⁰⁶ officially designated National Parks and other NPS affiliated areas, such as National Heritage Areas. Oregon has one National Park, one National Historic Site, two National Monuments, two National Historical Parks, and three National Historic Trails (Table 7.1.8-4) (NPS, 2015a). Figure 7.1.8-3 identifies all National Parks and

¹⁰⁶ This count is based on the NPS website “by the numbers” current as of September 30, 2014 (NPS, 2015a). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

affiliated areas located in Oregon. For additional information regarding parks and recreation areas, see Section 7.1.7, Land Use, Recreation, and Airspace.



Figure 7.1.8-2: Fort Vancouver National Historic Site

Source: (NPS, 2015g)

Table 7.1.8-4: Oregon National Parks and Affiliated Areas

Area Name	
California National Historic Trail	Lewis & Clark National Historical Park
Crater Lake National Park	Nez Perce National Historical Park
Fort Vancouver National Historic Site	Oregon National Historic Trail
John Day Fossil Beds National Monument	Oregon Caves National Monument & Preserve
Lewis & Clark National Historic Trail	

Source: (NPS, 2015a)

Bureau of Land Management

The BLM manages 15.7 million acres throughout Oregon including a national monument, cooperative management and protection area, and an outstanding natural area (BLM, 2014a) (BLM, 2015c). Table 7.1.8-5 identifies the BLM units in Oregon. BLM lands are managed under a multiple use mandate under the Federal Land Policy and Management Act (FLPMA) meaning that BLM must allow many uses of the lands, from recreation, to livestock grazing, forestry, wildlife habitat, and energy development (BLM, 2015d). 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.

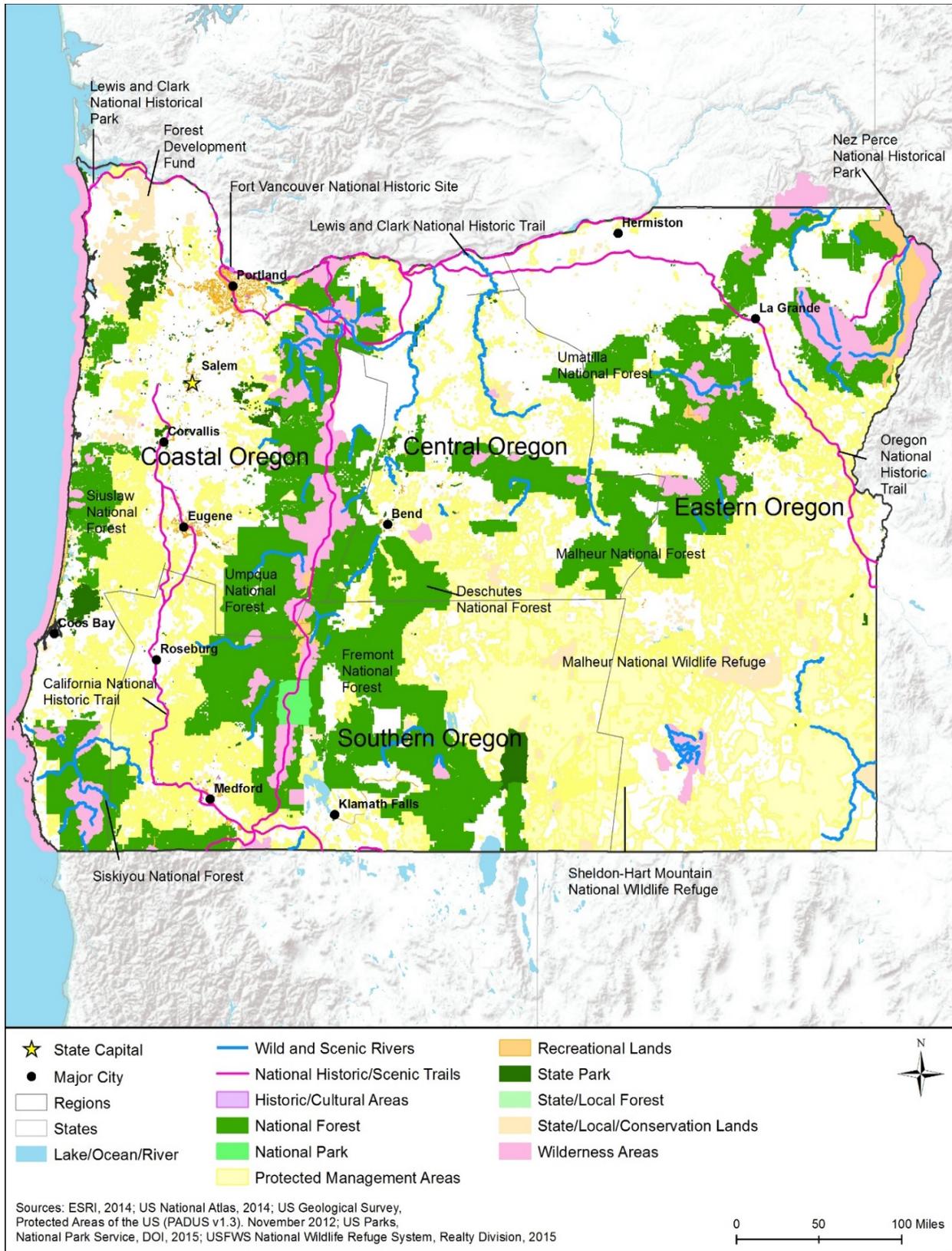


Figure 7.1.8-3: Natural Areas that May be Visually Sensitive

Table 7.1.8-5: Oregon BLM Areas of Scenic Value

BLM Area Name	
Burns - Andrews Resource Area	Prineville - Central Oregon Resource Area
Burns - Steens Mountain Cooperative Management and Protection Area	Prineville - Deschutes Resource Area
Burns - Three Rivers Resource Area	Roseburg - South River Resource Area
Coos Bay - Myrtlewood Resource Area	Roseburg - Swiftwater Resource Area
Coos Bay - Umpqua Resource Area	Salem - Cascades Resource Area
Eugene - Suislaw Resource Area	Salem - Marys Peak Resource Area
Eugene - Upper Willamette Resource Area	Salem - Tillamook Resource Area
Lakeview - Klamath Falls Resource Area	Salem - Yaquina Head Outstanding Natural Area
Lakeview - Lakeview Resource Area	Vale - Baker Resource Area Vale - National Historic Oregon Trail Interpretive Center (NHOTIC)
Medford - Ashland Resource Area	Vale - Jordan Resource Area
Medford - Butte Falls Resource Area	Vale - Malheur Resource Area
Medford - Cascade-Siskiyou National Monument	Vale - National Historic Oregon Trail Interpretive Center (NHOTIC)
Medford - Grants Pass Resource Area	

Source: (BLM, 2014a)

National Monuments

NPS defines a national monument as a “nationally significant resource...smaller than a national park and [lacking]...diversity of attractions.” Oregon is home to one national monument managed by NPS: John Day Fossil Beds (see Table 7.1.8-4 and Figure 7.1.8-3) (USFWS, 2016f). Additionally, the BLM designates national monuments to “afford protection, conservation, and restoration to landscapes of tremendous beauty, diversity, and historic or scientific interest” (BLM, 2015e). There is one national monument administered by BLM in Oregon: Cascade-Siskiyou National Monument (BLM, 2015c).

National Forests

There are 11 National Forests in Oregon managed by the USFS as shown in Table 7.1.8-6 and Figure 7.1.8-3 (USFS, 2015k). The USFS conducts inventories of the forestlands and assigns scenic resource categories from which they manage for scenic and visual resources (USFS, 1995). The scenic inventories are used to manage the forest landscape and to protect areas of high scenic integrity (USFS, 1995). Additionally, within the National Forests in Oregon, there are five congressionally designated areas: Mount Hood National Recreation Area, Cascade Head National Scenic Area, Oregon Dunes National Recreation Area, Newberry National Volcanic Monument, and Opal Creek Scenic Recreation Area (USFS, 2013). Due to the designation, these lands may receive greater protection of scenic resources than the surrounding forestlands.

Table 7.1.8-6: Oregon USFS National Forests

Forest Name	Acres
Deschutes National Forest	1.6M
Fremont-Wimena National Forest	2.3M
Malheur National Forest	1.7M
Mt. Hood National Forest	1M
Ochoco National Forest	845,000
Rogue River-Siskiyou National Forest	1.8M
Siuslaw National Forest	630,000
Umatilla National Forest	1.4M
Umpqua National Forest	983,000
Wallowa-Whitman National Forest	2.3M
Willamette National Forest	1.7M

Sources: (USFS, 2015k) (USFS, 2015l)

U.S. Forest Service National Recreation and Scenic Areas

National Recreation Areas are “lands and waters set aside for recreation use” (NPS, 2003). In Oregon, there is one National Recreation Area and one National Scenic Area that are managed by the USFS: Hells Canyon National Recreation Area and Columbia River Gorge National Scenic Area (see Figure 7.1.8-3). The Hells Canyon National Recreation Area within Wallowa-Whitman National Forest is composed of 652,488 acres along northeastern Oregon and western Idaho and includes the deepest river gorge in the U.S. Visual resources in this Recreation Area include mountain peaks and vistas, remote wilderness, wildlife, rustic remains, and prehistoric artifacts. (USFS, 2015m) The Columbia River Gorge National Scenic Area encompasses 292,500 acres stretching from “the mouth of the Sandy River to the mouth of the Deschutes River” and includes a canyon 4,000 feet deep and 80 miles long (USFS, 2015n).

U.S. Army Corps of Engineers Recreation Areas

There are 18 USACE recreation and flood risk management areas within the state (see Table 7.1.8-7 and Figure 7.1.8-3) (USACE, 2015a). These lakes are specifically managed by the USACE for scenic and aesthetic qualities in their planning guidance in addition to managing risks for floods (USACE, 1997).

Table 7.1.8-7: Oregon U.S. Army Corps of Engineers Recreation Areas

Recreation Area Name	
Blue River Lake	Foster Lake
Bonneville Lock and Dam	Green Peter Lake
Cottage Grove Lake	Hills Creek Lake
Cougar Lake	John Day Lock and Dam, Lake Umatilla
Detroit Lake	Lake Wallula
Dexter Lake	Lookout Point Lake
Dorena Lake	Lost Creek Lake
Fall Creek Lake	The Dalles Lock and Dam, Lake Celilo
Fern Ridge Lake	Willow Creek

Source: (USACE, 2015b)

Bureau of Reclamation

The Bureau of Reclamation’s “multipurpose approach to water resource development” includes offering recreation areas with important natural and cultural resources (Bureau of Reclamation, 2015b). When planning for recreation, the Bureau must ensure that “potential impacts to natural and cultural resources...are taken into consideration” (Bureau of Reclamation, 2009). Visual resources in these natural areas may revolve around water sources such as lakes, canals, and reservoirs. See Table 7.1.8-8 for the 24 Bureau of Reclamation Recreation Areas in Oregon (see Figure 7.1.8-3) (Bureau of Reclamation, 2015c).

Table 7.1.8-8: Oregon Bureau of Reclamation Recreation Areas

Recreation Area Name	
'A' Canal Trail	Hyatt Reservoir
Agate Reservoir	Lake Owyhee
Beulah Valley Reservoir	McKay Reservoir Wildlife Management Area
Bully Creek Reservoir	Phillips Lake
Clear Lake	Prineville Reservoir State Park & Wildlife Area
Cold Springs NWR	Thief Valley Reservoir
Crane Prairie Reservoir	Unity Reservoir
Emigrant Lake	Upper Klamath Lake
Gerber Reservoir	Upper Klamath NWR
Haystack Reservoir	Warm Springs Reservoir
Henry Hagg Lake	Wickiup Reservoir
Howard Prairie Lake	Wilson Reservoir

Source (Bureau of Reclamation, 2015c)

Federal and State Trails

Oregon State Parks are home to hundreds of miles of scenic hiking trails within 250 state parks, recreation, heritage, and natural areas (OPRD, 2015e). These trails have aesthetic resources such as forests, streams, wildlife, and birds (OPRD, 2015c). For additional information about trails in

the state parks and forests, select ‘Hiking’ on the Oregon State Parks’ ‘Find a Park’ website (OPRD, 2015c).

The National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015a). In Oregon, there are 64 National Recreation Trails administered by the BLM, USFWS, USFS, local and state governments, and private organizations (American Trails, 2015b).

State Parks, Scenic Areas, and Recreation Sites/Areas

State parks contain natural, historic, cultural, and/or recreational resources of significance to Oregon residents and visitors. The Oregon Department of Parks and Recreation manages over 250 state parks, scenic areas, and recreation sites/areas (see Figure 7.1.8-3), most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (OPRD, 2015e). Table 7.1.8-9 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, see the Oregon State Parks website (Oregon State Parks, 2015).

Table 7.1.8-9: Examples of Oregon State Parks and Associated Visual Attributes

State Park	Visual Attributes
Bates State Park	Old Mill Pond, valleys, wildlife, Middle Fork John Day River, Bridge Creek, Clear Creek, mountain vistas, birds
Collier Memorial State Park	Pioneer village, primitive horse camp, trailhead, Williamson River, Spring Creek, spring, forest
Molalla River State Park	Willamette River, Molalla River, Pudding River, floodplains, waterfowl, birds, wildlife, blue heron rookery, grassy fields
Smith Rock State Park	River canyon, birds, wildlife, rock peaks, pine forests, waterways
William M. Tugman State Park	Broad green lawns, Eel Lake, lakes, waterfowl, wildlife, forests (spruce, fir, alder, and cedar), brush-lined lake shore

Source: (OPRD, 2015c)



Source: (OPRD, 2015f)

Figure 7.1.8-4: Bates State Park

State Forests

The Oregon Division of Forestry manages 1,193 square miles of land (USGS, 2014g) in six state forests as well as other, smaller parcels, “to provide economic, environmental and social benefits,” most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (Oregon.gov, 2015a). Table 7.1.8-10 contains a list of Oregon state forests and Figure 7.1.8-3 displays them on the map.

Table 7.1.8-10: Oregon State Forests

Forest Name	
Clatsop State Forest	Santiam State Forest
Elliott State Forest	Sun Pass State Forest
Gilchrist State Forest	Tillamook State Forest

Source: (Oregon.gov, 2015a)

7.1.8.6. Natural Areas

The abundance of natural areas varies by state depending on the amount of public or state lands managed within each. Although many natural areas may not be managed specifically for visual resources, these areas are allowed protection for their natural resources and the resulting management protects these scenic resources. Figure 7.1.8-3 identifies natural areas that may have sensitive visual resources.

Rivers Designated as National or State Wild, Scenic or Recreational

National Wild, Scenic, or Recreational Rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. Portions of 59 rivers in Oregon, approximately 1,916.7 miles, have been designated National Wild and Scenic Rivers (see Figure 7.1.8-3 and Table 7.1.8-11) (National Wild and Scenic Rivers System, 2015a).

Table 7.1.8-11: Oregon National Wild and Scenic Rivers

River Name	
Big Marsh Creek	McKenzie River
Chetco River	Metolius River
Clackamas River	Minam River
Clackamas River (South Fork)	North Powder River
Collawash River	North Umpqua River
Crescent Creek	Owyhee River
Crooked River	Owyhee River (North Fork)
Crooked River (North Fork)	Powder River
Deschutes River	Quartzville Creek
Donner und Blitzen River	River Styx
Eagle Creek (Mt. Hood National Forest)	Roaring River
Eagle Creek (Wallowa-Whitman National Forest)	Roaring River (South Fork)
Elk River	Rogue River
Elkhorn Creek	Rogue River (Upper)

River Name	
Fifteenmile Creek	Salmon River
Fish Creek	Sandy River
Grande Ronde River	Smith River (North Fork)
Hood River (East Fork)	Snake River
Hood River (Middle Fork)	Sprague River
Illinois River	Squaw Creek
Imnaha River	Sycan River
John Day River	Wallowa River
John Day River (North Fork)	Wenaha River
John Day River (South Fork)	West Little Owyhee River
Joseph Creek	Whychus Creek
Klamath River	White River
Little Deschutes River	Wildhorse & Kiger Creeks
Lostine River	Willamette River (North Fork Middle Fork)
Malheur River	Zigzag River
Malheur River (North Fork)	

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



Figure 7.1.8-5: Deschutes Rivers

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

The Oregon Scenic Waterways Program was established in 1970 to “achieve a balance between protecting the rivers’ natural resources and the equally valuable lives and plans of the people who live along them” (Oregon.gov, 2015b). Specifically, the Program gives the Oregon Parks and Recreation Department (OPRD) the authority to protect and enhance values of identified scenic waterways with emphasis on various attributes that include scenic beauty (Oregon Secretary of State, 2015d). Twenty rivers, and/or portions thereof, are designated scenic waterways by the Oregon Scenic Waterways Program and are identified in Table 7.1.8-12 and shown on the map in Figure 7.1.8-3 (Oregon.gov, 2015b). The Program limits activities within ¼ mile of these waterways to prevent substantial impairment of “the natural beauty of the scenic waterway” (Oregon Secretary of State, 2015d).

Table 7.1.8-12: Oregon Scenic Waterways

Waterway Name	
Clackamas River	McKenzie River (South Fork)
Clackamas River (Upper)	Metolius River
Deschutes River	Minam River
Deschutes River (Upper)	Nestucca River
Deschutes River (Middle)	Owyhee River
Elk River	Rogue River
Grande Ronde River	Rogue River (Upper)
Illinois River	Sandy River
John Day River	Santiam River (Little North)
John Day River (North Fork)	Umpqua River (North)
John Day River (Middle Fork)	Waldo Lake
John Day River (South Fork)	Walker Creek
Klamath River	Wallowa River
McKenzie River (Upper)	Willamette River (North Fork of the Middle Fork)

Source: (Oregon Secretary of State, 2015d)

National Wildlife Refuges and State Wildlife Management Areas

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, 2015ag). There are 21 NWRs in Oregon identified in Table 7.1.8-13 and shown on the map in Figure 7.1.8-3 (USFWS, 2013e).

Table 7.1.8-13: Oregon National Wildlife Refuges

Refuge Name	
Ankeny NWR	Malheur NWR
Bandon Marsh NWR	McKay Creek NWR
Baskett Slough NWR	Nestucca Bay NWR
Bear Valley NWR	Oregon Islands NWR
Cape Meares NWR	Siletz Bay NWR
Cold Springs NWR	Three Arch Rocks NWR
Deer Flat NWR	Tualatin River NWR
Hart Mountain National Antelope Refuge	Umatilla NWR
Lewis and Clark NWR	Upper Klamath NWR
Lower Klamath NWR	William L. Finley NWR
Klamath Marsh NWR	

Source: (USFWS, 2016f)

ODFW owns or manages 23 wildlife areas on almost 200,000 acres for wildlife and recreation (see Table 7.1.8-14) (ODFW, 2015e).

Table 7.1.8-14: Oregon Wildlife Areas

Wildlife Area Name	
Bridge Creek Wildlife Area	Lower Deschutes Wildlife Area
Coquille Valley Wildlife Area	Phillip W. Schneider Wildlife Area
Coyote Springs Wildlife Area	Power City Wildlife Area
Dean Creek Elk Viewing Area	Prineville Reservoir Wildlife Area
Denman Wildlife Area	Riverside Wildlife Area
E.E. Wilson Wildlife Area	Sauvie Island Wildlife Area
Elkhorn Wildlife Area	Summer Lake Wildlife Area
Fern Ridge Wildlife Area	Wenaha Wildlife Area
Irrigon Wildlife Area	White River Wildlife Area
Jewell Meadows Wildlife Area	Willow Creek Wildlife Area
Klamath Wildlife Area	Winchester Dam Viewing Area
Ladd Marsh Wildlife Area	

Source: (ODFW, 2015e)

National Natural Landmarks

National Natural Landmarks (NNL) 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, 2014e). These landmarks may be considered visual resources or visually sensitive. In Oregon, there are 10 NNLs (see Table 7.1.8-15 and Figure 7.1.8-3). Some of the natural features located within these areas include the “largest Pleistocene volcano east of the Cascade Range, badlands containing over 30 mammalian families of fossils,” and the “largest remaining native unplowed example of bottomland interior valley grassland in the North Pacific Border bio-physiographic province” (USFWS, 2016f).

Table 7.1.8-15: Oregon National Natural Landmarks

NNL Name	
Crown Point	Newberry Crater
Fort Rock State Monument	Round Top Butte
Horse Ridge Natural Area	The Island
John Day Fossil Beds	Willamette Floodplain
Lawrence Memorial Grassland Preserve	Zumwalt Prairie

Source: (USFWS, 2016f)

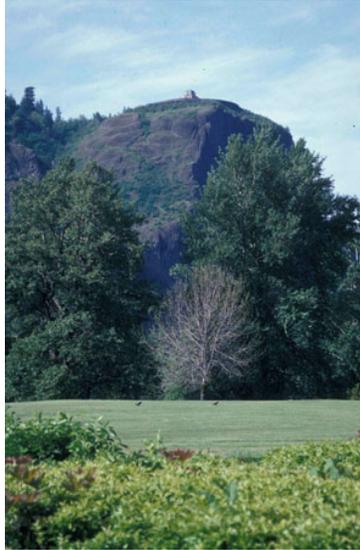


Figure 7.1.8-6: Crown Point

Source: (USFWS, 2016f)

National Grasslands

Crooked River National Grassland covers 173,629 acres in Central Oregon within sub-basins of the Middle Deschutes and Lower Crooked Rivers. The Grassland is within the 845,498 acres of the Ochoco National Forest, which includes scenic resources such as juniper, sagebrush, grasses, ponderosa pine, Douglas fir, white fir, western larch, and a variety of wildlife. (USFS, 2015o)

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.” 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.” A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. Over 106 million acres of federal public lands have been designated as wilderness areas. Twenty-five percent of these federal lands are in 47 national parks (about 26.5 million acres) and part of the National Park System. The USFS, BLM, and USFWS manage other designated wilderness areas. (NPS, 2015h)

Oregon is home to 47 federally managed Wilderness Areas identified in Table 7.1.8-16 and shown on the map in Figure 7.1.8-3.

Table 7.1.8-16: Oregon Wilderness Areas

Wilderness Name	
Badger Creek Wilderness	Mount Washington Wilderness
Black Canyon Wilderness	Mountain Lakes Wilderness
Boulder Creek Wilderness	North Fork John Day Wilderness
Bridge Creek Wilderness	North Fork Umatilla Wilderness
Bull of the Woods Wilderness	Opal Creek Wilderness
Clackamas Wilderness	Oregon Badlands Wilderness
Copper Salmon Wilderness	Oregon Islands Wilderness
Cummins Creek Wilderness	Red Buttes Wilderness
Diamond Peak Wilderness	Roaring River Wilderness
Drift Creek Wilderness	Rock Creek Wilderness
Eagle Cap Wilderness	Rogue-Umpqua Divide Wilderness
Gearhart Mountain Wilderness	Salmon-Huckleberry Wilderness
Grassy Knob Wilderness	Sky Lakes Wilderness
Hells Canyon Wilderness	Soda Mountain Wilderness
Kalmiopsis Wilderness	Spring Basin Wilderness
Lower White River Wilderness	Steens Mountain Wilderness
Mark O. Hatfield Wilderness	Strawberry Mountain Wilderness
Menagerie Wilderness	Table Rock Wilderness
Middle Santiam Wilderness	Three Arch Rocks Wilderness
Mill Creek Wilderness	Three Sisters Wilderness
Monument Rock Wilderness	Waldo Lake Wilderness
Mount Hood Wilderness	Wenaha-Tucannon Wilderness
Mount Jefferson Wilderness	Wild Rogue Wilderness
Mount Thielsen Wilderness	

Source: (Wilderness.net, 2015)

Cooperative Management and Protection Area

Steens Mountain Cooperative Management and Protection Area (CMPA) in southeastern Oregon encompasses 428,156 acres of scenic and recreational resources. The CMPA includes gorges, wilderness, wild rivers, and diverse plants and animals. The CMPA includes the 170,200 acres of the Steens Mountain Wilderness. The CMPA was designated by the Steens Mountain Cooperative Management and Protection Act of 2000 and is managed by the BLM and Steens Mountain Advisory Council to “conserve, protect, and manage the long-term ecological integrity of the Steens Mountain.” (BLM, 2015j)

Outstanding Natural Area

The BLM manages the Yaquina Head Outstanding Natural Area (ONA) in Oregon (see Figure 7.1.8-3). Yaquina Head ONA is a 14-million year old lava flow headland on the Pacific Coast of Oregon and is home to a 140-year old lighthouse, providing refuge for harbor seals and nesting seabirds (BLM, 2015f). Yaquina Head ONA is protected by BLM for its “unique scenic, scientific, educational, and recreational values” and is managed jointly with the state of Oregon, USFWS, and U.S. Coast Guard (BLM, 2015g). BLM lands are managed under a multiple use mandate, the Federal Land Policy and Management Act (FLPMA), meaning that BLM must allow many uses of the lands, from recreation, to livestock grazing, forestry, wildlife habitat, and

energy development (BLM, 2015d). The BLM uses their visual resources management system to “identify and evaluate scenic values to determine the appropriate levels of management.”

State Natural Areas

The Oregon Natural Areas Preserves Act of 1973 established conservation of natural areas within Oregon as a state priority. Since 1993 the Oregon Parks and Recreation Department (OPRD) has administered 21 state natural areas “(1) to protect examples of terrestrial and aquatic ecosystems; (2) to serve as gene pool reserves; (3) to serve as benchmarks against which the influences of human activities may be compared; and (4) to provide outdoor laboratories for research and education” (OPRD, 2015c). In addition to these (see Table 7.1.8-17), another ten state natural areas, research natural areas, marine reserves, and preserves are managed by the Department of State Lands, Ocean Policy Advisory Council, and local and county governments. (Natural Heritage Advisory Council to the State Land Board, 2010) Additionally, natural and conservation areas also include 28 properties owned and managed (often jointly) by a variety of entities including USFWS, ODFW, USFS, ODSL, BLM, local and tribal governments, and private organizations, such as The Nature Conservancy (The Nature Conservancy, 2015a). These properties include Agate Desert, Eight Dollar Mountain, Popcorn Swale, The Table Rocks, and Zumwalt Prairie (The Nature Conservancy, 2015a). Agate Desert Preserve is home to rare wildflowers and prairie grasses, and vernal pools in a usually dry habitat (The Nature Conservancy, 2015b).

Table 7.1.8-17: Oregon State Natural Areas

Natural Area Name	
Bandon State Natural Area	Munson Creek Falls State Natural Site
Cape Kiwanda State Natural Area	Saddle Mountain State Natural Area
Clay Myers State Natural Area at Whalen Island	Seneca Fouts Memorial State Natural Area
Coquille Myrtle Grove State Natural Site	Shepperd’s Dell State Natural Area
Darlingtonia State Natural Site	Succor Creek State Natural Area
Devils Punchbowl State Natural Area	Tokatee Klootchman State Natural Site
Erratic Rock State Natural Site	Tryon Creek State Natural Area
Fort Rock State Natural Area	Vinzenz Lausmann Memorial State Natural Area
George W. Joseph State Natural Area	Wygant State Natural Area
Golden and Silver Falls State Natural Area	Yachats Ocean Road State Natural Site
Luckiamute Landing State Natural Area	

Source: (OPRD, 2015c)

National and State Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. Oregon has ten designated National Scenic Byways noted in Table 7.1.8-18 and shown on the map in Figure 7.1.8-3. Mt. Hood Scenic Byway traces 105 miles along a route where volcanoes and floods cut deep gorges. Volcanic Legacy Scenic Byway connects Crater Lake National Park to Lassen Volcanic National Park in California and includes scenic resources such as mountain lakes, quaint towns, wildlife, birds, and historical and cultural sites. (FHWA, 2015c)

Table 7.1.8-18: Oregon National Scenic Byways

State Byway Name	Mileage
Cascade Lakes Scenic Byway	66
Hells Canyon Scenic Byway	218
Historic Columbia River Highway	70
McKenzie Pass-Santiam Pass Scenic Byway	82
Mt. Hood Scenic Byway	105
Outback Scenic Byway	170
Pacific Coast Scenic Byway	363
Rogue-Umpqua Scenic Byway	172
Volcanic Legacy Scenic Byway	500
West Cascades Scenic Byway	220

Source: (FHWA, 2015c)

Similar to National Scenic Byways, the Oregon Transportation Commission and Oregon Tourism Commission designate state scenic byways and tour routes to “recognize scenic byways across jurisdictional boundaries, to orient and focus on the tourist or motorist and to show off the best in the way of scenic byways (Oregon Secretary of State, 2015a). The Oregon State Byways Program recognizes six scenic byways and ten tour routes noted in Table 7.1.8-19 and shown on the map in Figure 7.1.8-3 (Oregon.gov, 2015c).

Table 7.1.8-19: Oregon State Scenic Byways and Tour Routes

State Byway Name	Mileage
Blue Mountain Scenic Byway	145
Charleston to Bandon Tour Route	41
Cottage Grove Covered Bridge Tour Route	20
Cow Creek Tour Route	45
Diamond Loop Tour Route	69
East Steens Tour Route	143
Elkhorn Scenic Byway	106
Grande Tour Route	80
High Desert Discovery Scenic Byway	127
Journey Through Time Scenic Byway	286
Myrtle Creek-Canyonville Tour Route	68
Over the Rivers & Through the Woods Scenic Byway	66
Silver Falls Tour Route	55
Steen Loop Tour Route	59
Umpqua Scenic Byway	66
Vineyard and Valley Tour Route	50

Source: (Oregon.gov, 2015d)

Additionally, the Oregon Parks and Recreation Department (OPRD) maintains eight waysides and greenways as part of the state parks system (see Table 7.1.8-20) (OPRD, 2015c).

Table 7.1.8-20: Oregon State Waysides and Greenways

State Wayside or Greenway Name	
Alderwood State Wayside	Red Bridge State Wayside
Chandler State Wayside	Tub Springs State Wayside
Ellmaker State Wayside	Wallowa River Wayside
Hoffman Memorial State Wayside	Willamette River Greenway

Source: (OPRD, 2015c)

7.1.9. Socioeconomics

7.1.9.1. Definition of the Resource

NEPA requires consideration of socioeconomics in NEPA analysis; specifically, Section 102(A) of NEPA requires federal agencies to “insure the integrated use of the natural and social sciences...in planning and in decision making” (42 U.S.C. § 4332(A)). Socioeconomics refers to a broad, social science-based approach to understanding a region’s social and economic conditions. It typically includes population, demographic descriptors, economic activity indicators, housing characteristics, property values, and public revenues and expenditures (BLM, 2005). When applicable, it includes qualitative factors such as community cohesion. Socioeconomics provides important context for analysis of FirstNet Proposed Actions, and in addition, FirstNet Proposed Actions may affect the socioeconomic conditions of a region.

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal 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. This PEIS addresses environmental justice in a separate section (Section 7.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: Land Use, Recreation, and Airspace (Section 7.1.7), Infrastructure (Section 7.1.1), and Visual Resources (Section 7.1.8).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau¹⁰⁷ (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data is typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for years other than the decennial census years. This PEIS uses the 2009-2013 ACS, which is based on surveys (population samples) taken across that five-year period; thus, it is not appropriate to attribute its data values to a specific year. It is a valuable source because it provides the most accurate and consistent socioeconomic data across the nation at the sub-county level (U.S. Census Bureau, 2016).

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

7.1.9.2. 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.

7.1.9.3. Communities and Populations

This section discusses the population and major communities of Oregon (OR) and includes the following topics:

¹⁰⁷ For U.S. Census Bureau sources, a URL (see references section) that begins with "http://factfinder.census.gov" indicates that the American FactFinder (AFF) interactive tool can be used to retrieve the original source data via the following procedure. If the reference's URL begins with "http://dataferrett.census.gov," significant socioeconomic expertise is required to navigate this interactive tool to the specific data. However, the data can usually be found using AFF. As of May 24, 2016, the AFF procedure is as follows: 1) Go to <http://factfinder.census.gov>. 2) Select "Advanced Search," then "Show Me All." 3) Select from "Topics" choices, select "Dataset," then select the dataset indicated in the reference; e.g., "American Community Survey, 2013 1-Year Estimates" or "2012 Census of Governments." Click "Close." Note: ACS is the abbreviation in the AFF for the American Community Survey. SF is the abbreviation used with the 2000 and 2010 "Summary Files." For references to the "2009-2013 5-Year Summary File," choose "2013 ACS 5-year estimates" in the AFF. 4) Click the "Geographies" box. Under "Select a geographic type," choose the appropriate type; e.g., "United States - 010" or "State - 040" or "... County - 050" then select the desired area or areas of interest. Click "Add to Your Selections," then "Close." For Population Concentration data, select "Urban Area - 400" as the geographic type, then select 2010 under "Select a version" and then choose the desired area or areas. Alternatively, do not choose a version, and select "All Urban Areas within United States." Regional values cannot be viewed in the AFF because the regions for this PEIS do not match Census Bureau regions. All regional values were developed by downloading state data and using the most mathematically appropriate calculations (e.g., sums of state values, weighted averages, etc.) for the specific data. 5) In "Refine your search results," type the table number indicated in the reference; e.g., "DP04" or "LGF001." The dialogue box should auto-populate with the name of the table(s) to allow the user to select the table number/name. Click "Go." 6) In the resulting window, click the desired table under "Table, File, or Document Title" to view the results. If multiple geographies were selected, it is often easiest to view the data by clicking the "Download" button above the on-screen data table. Choose the desired comma-delimited format or presentation-ready format (includes a Microsoft Excel option). In some cases, the structure of the resulting file may be easier to work with under one format or another. Note that in most cases, the on-screen or downloaded data contains additional parameters besides those used in the FirstNet PEIS report table. Readers must locate the FirstNet PEIS-specific data within the Census Bureau tables. In many cases, the FirstNet PEIS report tables contain data from multiple Census Bureau tables and sometimes incorporate other sources.

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

Statewide Population and Population Growth

Table 7.1.9-1 presents the 2014 population and population density of Oregon in comparison to the West region¹⁰⁸ and the nation. The estimated population of Oregon in 2014 was 3,970,239. The population density was 41 persons per square mile (sq. mi.), which is considerably lower (less than half) than the population density of both the region (98 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2014, Oregon was the 27th largest state by population among the 50 states and the District of Columbia, 10th largest by land area, and had the 40th greatest population density (U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015i).

Table 7.1.9-1: Land Area, Population, and Population Density of Oregon

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2014 (persons/sq. mi.)
Oregon	95,988	3,970,239	41
West Region	624,241	61,039,316	98
United States	3,531,905	318,857,056	90

Sources: (U.S. Census Bureau, 2015h; U.S. Census Bureau, 2015i)

Population growth is an important subject for this PEIS given FirstNet’s mission. Table 7.1.9-2 presents the population growth trends of Oregon from 2000 to 2014 in comparison to the West region and the nation. The state’s annual growth rate decreased slightly in the 2010 to 2014 period compared to 2000 to 2010, from 1.14 percent to 0.90 percent. The growth rate of Oregon in the 2010 to 2014 period was slightly lower than the growth rate of the region, at 1.08 percent, and slightly higher when compared to the nation’s growth rate of 0.81 percent.

Table 7.1.9-2: Recent Population Growth of Oregon

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
Oregon	3,421,399	3,831,074	3,970,239	409,675	139,165	1.14%	0.90%
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%

Sources: (U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015h)

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

Demographers prepare future population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use population projections that apply

¹⁰⁸ The West region is composed 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.

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 7.1.9-3 presents projections of the 2030 population from two sources that are national in scope and use different methodologies: the University of Virginia’s Weldon Cooper Center for Public Service and ProximityOne, a private sector demographic and economic data, and analysis service (ProximityOne, 2015) (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 Oregon’s population will increase by approximately 529,000 people, or 13.3 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 0.78 percent, which is slightly lower than the historical growth rate from 2010 to 2014 of 0.90 percent. The projected growth rate of the state is lower than that of the region (1.03 percent) and nearly matches the projected growth rate of the nation (0.80 percent).

Table 7.1.9-3: Projected Population Growth of Oregon

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
Oregon	3,970,239	4,597,030	4,401,617	4,499,324	529,085	13.3%	0.78%
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, 2015h; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)
 AARC = Average Annual Rate of Change (compound growth rate)

Population Distribution and Communities

Figure 7.1.9-1 presents the distribution and relative density of the population of Oregon. 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, 2015k).

This map also presents the 10 largest population concentrations in the state, outlined in purple. These population concentrations reflect contiguous, densely developed areas as defined by the Census Bureau based on the 2010 census (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015l). These population concentrations often include multiple incorporated areas as well as some unincorporated areas.

Other groupings of brown dots on the map represent additional, but smaller, population concentrations. Dispersed dots indicate dispersed population across the less densely settled areas of the state. The very sparsely populated area in the southeastern portion of the state is the

Columbia Plateau, a predominantly forested, mountainous region. For more information about the Columbia Plateau, see Section 7.1.7, Land Use, Recreation, and Airspace.

Table 7.1.9-4 provides the populations of the 10 largest population concentrations in Oregon, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.¹⁰⁹ In 2010, the largest population concentration by far was the Oregon portion of the Portland area, which had approximately 1.5 million people. The state had no other population concentrations over 1 million. The second largest area (Eugene area) had a population of 247,421 people. The smallest of these 10 population concentrations was the Klamath Falls/Altamont area, with a 2010 population of 41,434. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Bend area, with an annual growth rate of 3.83 percent. The only other area with a growth rate over 3.00 percent was the Albany area (3.05 percent).

Table 7.1.9-4 also shows that the top 10 population concentrations in Oregon accounted for 64.4 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 79.4 percent of the entire state's growth.

¹⁰⁹ 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.

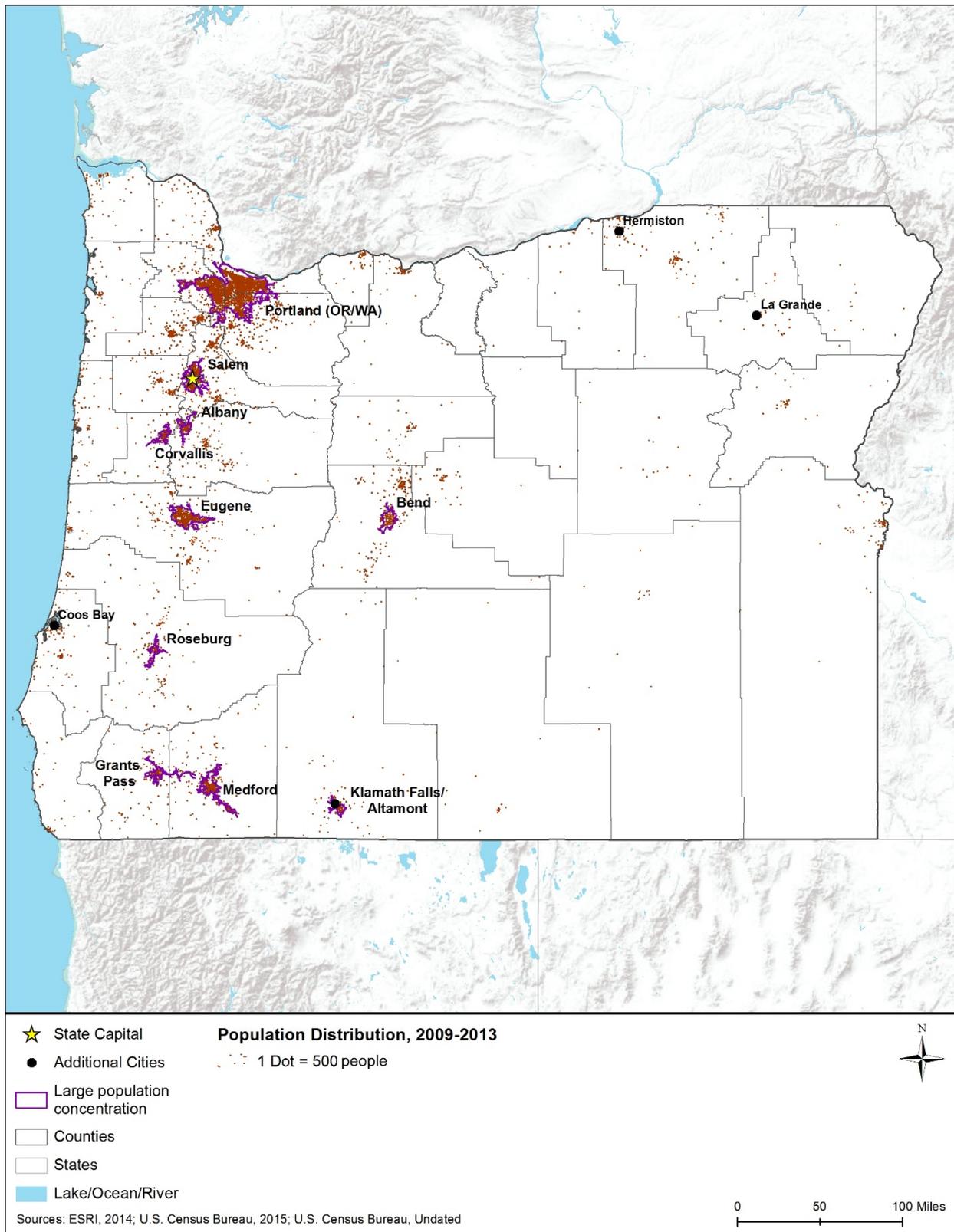


Figure 7.1.9-1: Population Distribution in Oregon, 2009–2013

Table 7.1.9-4: Population of the 10 Largest Population Concentrations in Oregon

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Albany	42,193	56,997	57,438	7	14,804	3.05%
Bend	57,525	83,794	84,589	5	26,269	3.83%
Corvallis	58,229	62,433	62,857	6	4,204	0.70%
Eugene	224,049	247,421	250,676	2	23,372	1.00%
Grants Pass	43,811	50,520	50,608	8	6,709	1.44%
Klamath Falls/Altamont	41,153	41,434	40,769	10	281	0.07%
Medford	128,780	154,081	156,557	4	25,301	1.81%
Portland (OR/WA) (OR Portion)	1,298,697	1,490,336	1,517,967	1	191,639	1.39%
Roseburg	38,212	41,700	42,736	9	3,488	0.88%
Salem	207,229	236,632	238,900	3	29,403	1.34%
Total for Top 10 Population Concentrations	2,139,878	2,465,348	2,503,097	NA	325,470	1.43%
Oregon (statewide)	3,421,399	3,831,074	3,868,721	NA	409,675	1.14%
Top 10 Total as Percentage of State	62.5%	64.4%	64.7%	NA	79.4%	NA

Sources: (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015m; U.S. Census Bureau, 2015n)
 AARC = Average Annual Rate of Change (compound growth rate)

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

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet Proposed Actions are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 7.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 7.1.9-5 compares several economic indicators for Oregon to the West region and the nation. The table presents two indicators of income¹¹⁰ – per capita and median household – as income is a good measure of general economic health of a region.

¹¹⁰ 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;

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 7.1.9-5, the per capita income in Oregon in 2013 (\$27,048) was \$1,610 lower than that of the region (\$28,658), and \$1,136 lower than that of the nation (\$28,184). (BLS, 2015a; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q).

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 7.1.9-5 shows that in 2013, the MHI in Oregon (\$50,228) was \$6,843 lower than that of the region (\$57,071), and \$2,022 lower than that of the nation (\$52,250). (BLS, 2015a; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q).

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 7.1.9-5 compares the unemployment rate in Oregon to the West region and the nation. In 2014, Oregon’s statewide unemployment rate of 6.9 percent was slightly lower than the rate for the region (7.2 percent) and higher than the rate for the nation (6.2 percent)¹¹¹. (BLS, 2015a; U.S. Census Bureau, 2015o; U.S. Census Bureau, 2015p; U.S. Census Bureau, 2015q).

Table 7.1.9-5: Selected Economic Indicators for Oregon

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Oregon	\$27,048	\$50,228	6.9%
West Region	\$28,658	\$57,071	7.2%
United States	\$28,184	\$52,250	6.2%

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

Figure 7.1.9-2 and Figure 7.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015r) and unemployment in 2014 (BLS, 2015b) varied by county across the state. These maps also incorporate the same population concentration data as Figure 7.1.9-1 (U.S. Census Bureau, 2012);

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, 2015w)

¹¹¹ The timeframe for unemployment rates can change quarterly.

U.S. Census Bureau, 2015). Following these two maps, Table 7.1.9-6 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 Oregon.

Figure 7.1.9-2 shows that only a few counties around the Oregon portion of the Portland area had MHI levels above the national median. Most of the remainder of the state had MHI levels below the national average. Table 7.1.9-6 is consistent with those observations. It shows that MHI in the Oregon portion of the Portland area was above the state average (\$50,228). This was also the case for the Bend area MHI. In all other population concentrations, MHI levels were below the state average. MHI was lowest in the Grants Pass, Roseburg, and Klamath Falls/Altamont areas. These are the three smallest areas shown in the table.

Figure 7.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (i.e., better employment performance) were found around the Oregon portion of the Portland area and the Corvallis area. The remainder of the state had unemployment levels above the national average. The highest unemployment rates were generally in the counties located in the southern portion of the state. When comparing unemployment in the population concentrations to the state average (Table 7.1.9-6), only the Oregon portion of the Portland area, and the Bend and Corvallis areas had lower 2009–2013 unemployment rates than the state average.

Detailed employment data provides useful insights into the nature of a local, state, or national economy. Table 7.1.9-7 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 similar in Oregon to the West region and the nation. The percentage of government workers was also similar in the state, region, and nation. Self-employed workers were a similar percentage in the state as the region and a higher percentage than in the nation.

By industry, Oregon has a mixed economic base. In 2013, all industries in Oregon had percentages of workers that were similar (within two percentage points) to the figures for the region and the nation.

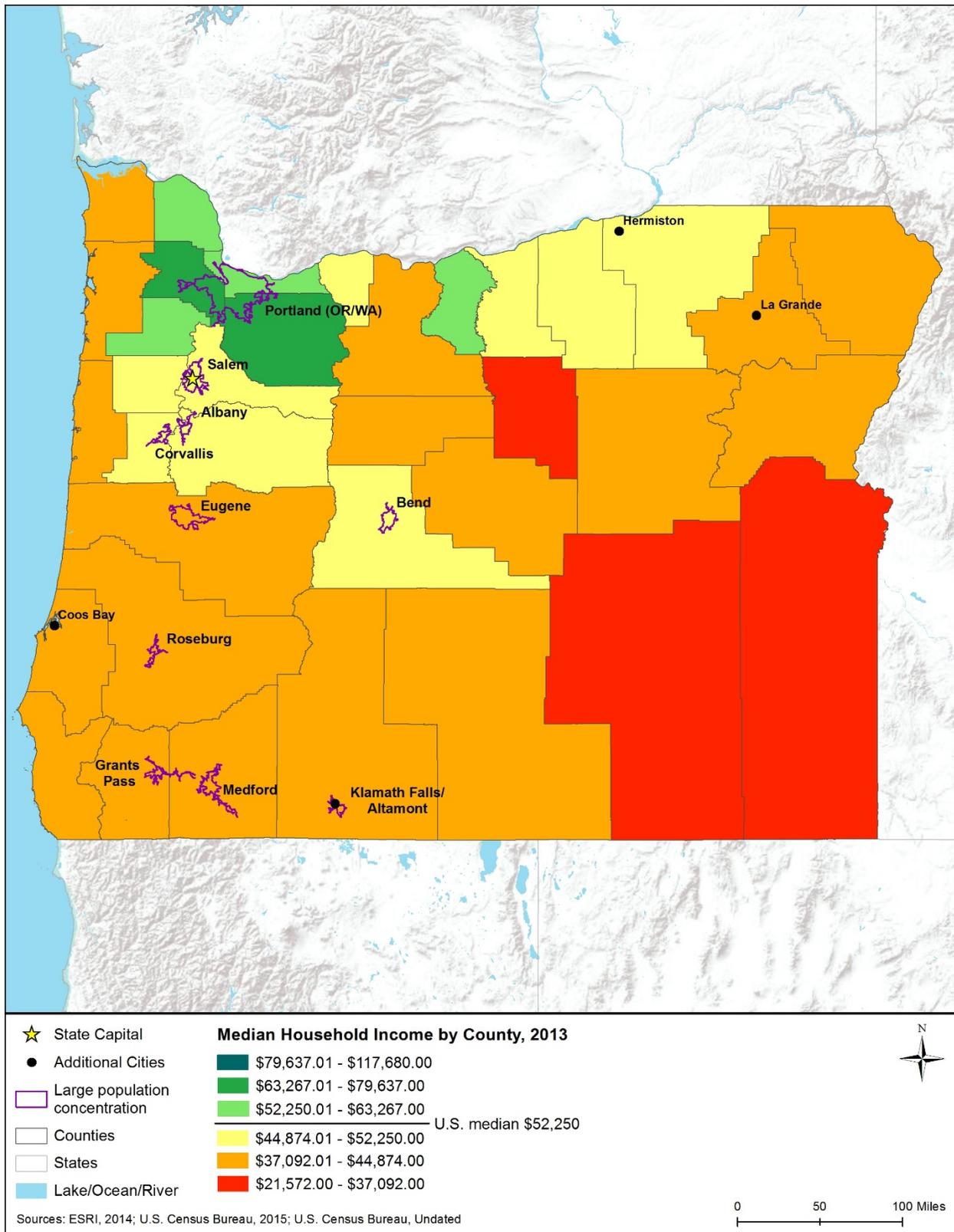


Figure 7.1.9-2: Median Household Income in Oregon, by County, 2013

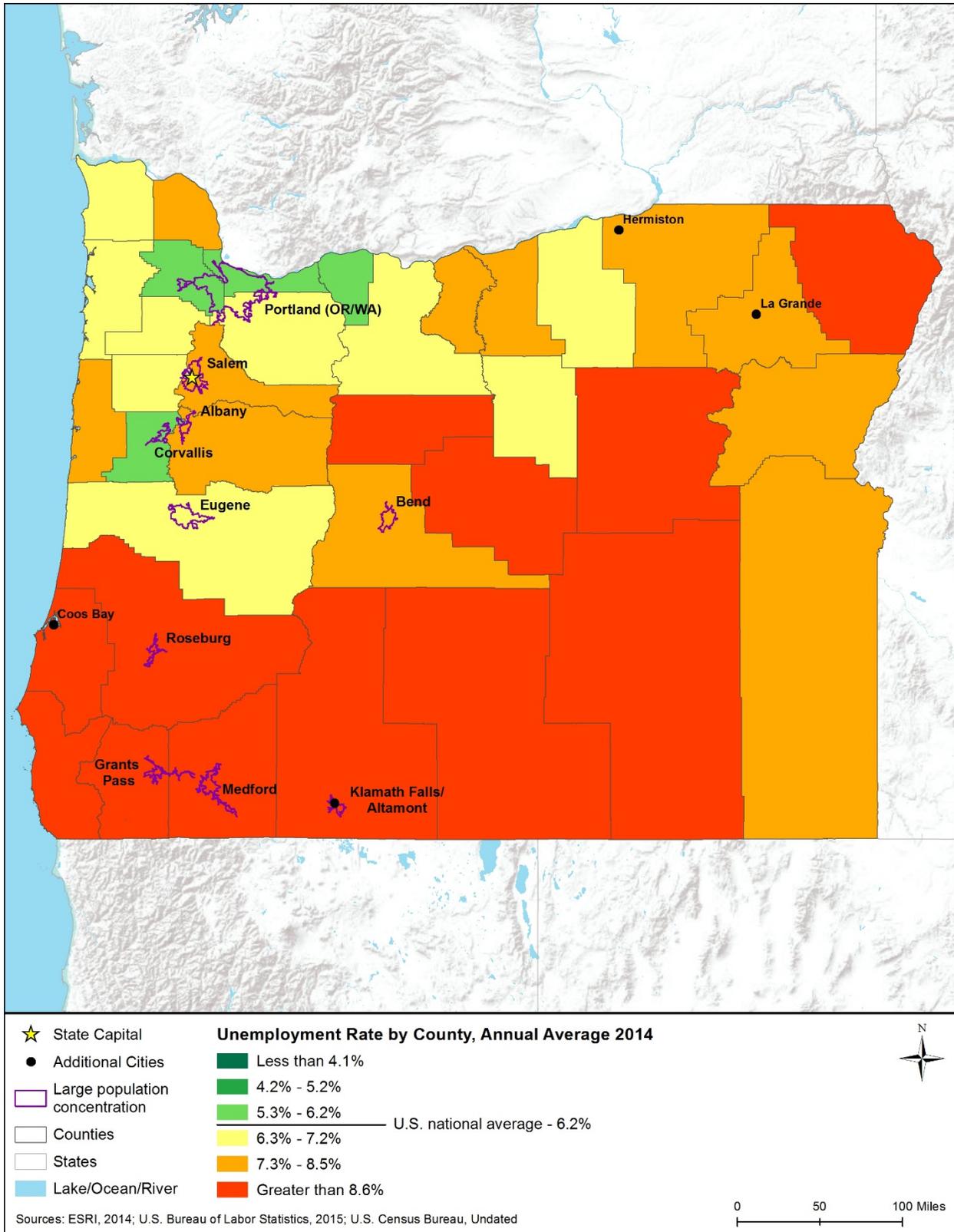


Figure 7.1.9-3: Unemployment Rates in Oregon, by County, 2014

Table 7.1.9-6: Selected Economic Indicators for the 10 Largest Population Concentrations in Oregon, 2009–2013

Area	Median Household Income	Average Annual Unemployment Rate
Albany	\$47,965	11.4%
Bend	\$52,844	9.6%
Corvallis	\$41,850	8.2%
Eugene	\$42,215	12.3%
Grants Pass	\$33,836	15.6%
Klamath Falls/Altamont	\$36,372	13.9%
Medford	\$42,750	12.4%
Portland (OR/WA) (OR Portion)	\$57,718	10.2%
Roseburg	\$38,556	16.5%
Salem	\$46,774	13.1%
Oregon (statewide)	\$50,228	11.3%

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

Table 7.1.9-7: Employment by Class of Worker and by Industry, 2013

Class of Worker and Industry	Oregon	West Region	United States
Civilian Employed Population 16 Years and Over	1,785,619	26,912,315	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	78.5%	78.4%	79.7%
Government workers	13.7%	13.9%	14.1%
Self-employed in own not incorporated business workers	7.6%	7.5%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	3.6%	2.5%	2.0%
Construction	5.7%	6.1%	6.2%
Manufacturing	11.3%	9.5%	10.5%
Wholesale trade	3.1%	2.9%	2.7%
Retail trade	12.3%	11.6%	11.6%
Transportation and warehousing, and utilities	4.0%	4.7%	4.9%
Information	1.9%	2.6%	2.1%
Finance and insurance, and real estate and rental and leasing	5.8%	6.3%	6.6%
Professional, scientific, management, administrative, and waste management services	10.7%	12.3%	11.1%
Educational services, and health care and social assistance	22.5%	20.9%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	9.9%	10.9%	9.7%
Other services, except public administration	5.1%	5.2%	5.0%
Public administration	4.1%	4.6%	4.7%

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

Table 7.1.9-8 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 7.1.9-7 for 2013.

Table 7.1.9-8: Employment by Selected Industries for the 10 Largest Population Concentrations in Oregon, 2009–2013

Area	Construction	Transportation and Warehousing, and Utilities	Information	Professional, Scientific, Management, Administrative and Waste Management Services
Albany	5.0%	3.9%	2.0%	9.6%
Bend	6.5%	2.9%	3.7%	12.4%
Corvallis	3.3%	1.7%	1.7%	10.5%
Eugene	4.7%	3.2%	2.3%	9.9%
Grants Pass	4.3%	5.4%	2.1%	7.4%
Klamath Falls/Altamont	4.0%	5.7%	1.0%	9.7%
Medford	4.3%	3.8%	2.5%	8.6%
Portland (OR/WA) (OR Portion)	4.8%	4.2%	2.2%	12.8%
Roseburg	4.5%	4.3%	1.1%	7.6%
Salem	5.6%	3.0%	1.2%	8.1%
Oregon (statewide)	5.6%	4.2%	1.9%	10.4%

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

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 7.1.9-9 compares Oregon to the West region and nation on several common housing indicators.

As shown in Table 7.1.9-9, in 2013, Oregon had a slightly higher percentage of housing units that were occupied (90.5 percent) than the region (89.9 percent) or nation (87.6 percent). Of the occupied units, Oregon had a slightly higher percentage of owner-occupied units (60.8 percent) than the region (56.8 percent), and a slightly lower percentage when compared to the nation (63.5 percent). The percentage of detached single-unit housing (also known as single-family homes) in Oregon in 2013 (63.6 percent) was slightly higher than the percentages in the region (60.3 percent) and the nation (61.5 percent). The homeowner vacancy rate in Oregon (1.6 percent) matched the rate for the region and was lower than the rate for the nation (1.9 percent). This rate reflects “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2015w). The vacancy rate among rental units was lower in Oregon (4.4 percent) than in the region (5.1 percent) or nation (6.5 percent).

Table 7.1.9-9: Selected Housing Indicators for Oregon, 2013

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Oregon	1,684,107	90.5%	60.8%	1.6%	4.4%	63.6%
West Region	23,159,156	89.9%	56.8%	1.6%	5.1%	60.3%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

Table 7.1.9-10 provides housing indicators for the largest population concentrations in the state by 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 7.1.9-10 shows that during this period, the percentage of occupied housing units ranged from 89.4 to 94.5 percent across these population concentrations.

Table 7.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Oregon, 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
Albany	23,200	93.3%	61.4%	1.8%	6.4%	64.9%
Bend	38,447	89.4%	59.4%	3.2%	7.9%	70.0%
Corvallis	26,727	90.9%	48.8%	0.6%	7.4%	51.3%
Eugene	108,419	94.5%	53.8%	1.9%	3.7%	58.8%
Grants Pass	22,998	92.2%	54.7%	2.6%	5.3%	61.2%
Klamath Falls/Altamont	18,871	89.9%	57.5%	3.9%	8.9%	65.0%
Medford	68,032	92.5%	57.0%	1.7%	4.5%	62.3%
Portland (OR/WA) (OR Portion)	635,382	94.3%	57.7%	1.9%	4.1%	58.2%
Roseburg	19,355	91.8%	60.1%	1.4%	7.6%	60.0%
Salem	92,473	94.3%	56.8%	1.4%	4.7%	60.7%
Oregon (statewide)	1,677,363	90.4%	62.0%	2.0%	5.1%	63.8%

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

Property Values

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

Table 7.1.9-11 provides indicators of residential property values for Oregon 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, 2015w).

The table shows that the median value of owner-occupied units in Oregon in 2013 (\$229,700) was lower than the corresponding value for the West region (\$301,787), but higher than the value for the nation (\$173,900).

Table 7.1.9-11: Residential Property Values in Oregon, 2013

Geography	Median Value of Owner-Occupied Units
Oregon	\$229,700
West Region	\$301,787
United States	\$173,900

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

Table 7.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Only the Oregon portion of the Portland area and the Bend and Corvallis areas had median values higher than the state median value (\$238,000). All other population concentrations had property values below the state value. The lowest values were in two of the areas – Klamath Falls/Altamont, and Roseburg – that had lower median household incomes (Table 7.1.9-6).

Government Revenues

State and local governments obtain revenues from many sources. FirstNet 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 taxes¹¹² are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

¹¹² Public utility taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Bureau of the Census 2006).

Table 7.1.9-12: Residential Property Values for the 10 Largest Population Concentrations in Oregon, 2009–2013

Area	Median Value of Owner-Occupied Units
Albany	\$177,200
Bend	\$249,900
Corvallis	\$257,100
Eugene	\$214,500
Grants Pass	\$184,600
Klamath Falls/Altamont	\$140,400
Medford	\$209,500
Portland (OR/WA) (OR Portion)	\$279,100
Roseburg	\$152,500
Salem	\$187,900
Oregon (statewide)	\$238,000

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

Table 7.1.9-13 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 7.1.9-13 shows that the state government in Oregon received more total revenue in 2012 on a per capita basis than its counterpart governments in the region and nation. Local governments in Oregon, on the other hand, received less total revenue in 2012 on a per capita basis than counterpart governments in the region and nation. Oregon state and local governments had higher levels per capita of intergovernmental revenue¹¹³ from the federal government than their counterparts in the region and nation. The Oregon state government obtained minimal revenue from property taxes, while Oregon local governments received higher property taxes per capita than local governments in the region and nation. State and local governments in Oregon obtained no revenue from general sales taxes. They received levels of selective sales taxes that were mostly similar on a per capita based to the levels for their counterparts regionally and nationally. The state government received less revenue per capita from public utility taxes than its counterpart governments in the region and nation. Oregon local governments received more. Individual and corporate income tax revenues, on a per capita basis, mostly were significantly higher for the state government in Oregon than for counterpart governments in the region and nation (per capita corporate tax revenues were slightly lower for

¹¹³ Intergovernmental revenues are those revenues received by one level of government from another level of government, such as shared taxes, grants, or loans and advances (U.S. Census Bureau, 2006).

the Oregon state government compared to state governments nationally). Local governments in Oregon obtained no revenue from individual income tax and similar levels of corporate income tax revenues to their counterpart governments in the region and nation.

Table 7.1.9-13: State and Local Government Revenues, Selected Sources, 2012

Type of Revenue	Oregon		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue (\$M)	\$25,059	\$18,005	\$372,535	\$354,200	\$1,907,027	\$1,615,194
Per capita	\$6,427	\$4,617	\$6,235	\$5,928	\$6,075	\$5,145
Intergovernmental from Federal (\$M)	\$7,831	\$1,082	\$44,368	\$15,822	\$514,139	\$70,360
Per capita	\$2,008	\$392	\$743	\$265	\$1,638	\$224
Intergovernmental from State (\$M)	\$0	\$5,615	\$87,966	\$117,358	\$0	\$469,147
Per capita	\$0	\$2,035	\$1,472	\$1,964	\$0	\$1,495
Intergovernmental from Local (\$M)	\$16	\$0	\$880	\$0	\$19,518	\$0
Per capita	\$4	\$0	\$15	\$0	\$62	\$0
Property Taxes (\$M)	\$16	\$5,019	\$52,387	\$71,927	\$13,111	\$432,989
Per capita	\$4	\$1,819	\$877	\$1,204	\$42	\$1,379
General Sales Taxes (\$M)	\$0	\$0	\$31,184	\$14,896	\$245,446	\$69,350
Per capita	\$0	\$0	\$522	\$249	\$782	\$221
Selective Sales Taxes (\$M)	\$1,399	\$372	\$13,934	\$7,418	\$133,098	\$28,553
Per capita	\$359	\$135	\$233	\$124	\$424	\$91
Public Utilities Taxes (\$M)	\$94	\$226	\$3,644	\$4,323	\$14,564	\$14,105
Per capita	\$24	\$82	\$61	\$72	\$46	\$45
Individual Income Taxes (\$M)	\$5,826	\$0	\$10,133	\$0	\$280,693	\$26,642
Per capita	\$1,494	\$0	\$170	\$0	\$894	\$85
Corporate Income Taxes (\$M)	\$433	\$52	\$1,270	\$52	\$41,821	\$7,210
Per capita	\$111	\$19	\$21	\$1	\$133	\$23

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

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

7.1.10. Environmental Justice

7.1.10.1. 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 1.8.11, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations).¹¹⁴ The fundamental principle of environmental justice is, “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with

¹¹⁴ See <https://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice>.

respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2016b). Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 2013b).

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

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).

7.1.10.2. Specific Regulatory Considerations

In 1997, Oregon established an environmental justice policy¹¹⁵ to provide a framework and guidance to ODEQ’s work. The policy included principles and implementation measures for integrating environmental equity into the agency’s decisions. (Oregon DEQ, 2015i)

The following implementation measures were included in the state’s environmental justice policy:

1. Ensure development and targeting of all agency outreach and education efforts to reach low-income and minority interests.
2. Ensure representation of minority and low-income interests on advisory committees.
3. Ensure that permit writers identify and address low income and minority issues in the permitting process.
4. Schedule agency meetings in facilities that meet American Disability Act requirements.

¹¹⁵ Oregon’s 1997 Environmental Justice Policy available at: <http://www.deq.state.or.us/nwr/docs/1997DEQ-EJ-policy.pdf>.

5. Ensure that water quality policy is consistent statewide.
6. Coordinate water quality data collection with other agencies.
7. Ensure that risk assessment includes adequate data on levels of fish consumption by various ethnic groups. Ensure that communication and outreach efforts are directed to these groups as well.
8. Identify ways to lessen potential water pollution from residential wells in rural areas, especially for low-income and minority communities.
9. Ensure that educational and outreach efforts regarding household hazardous waste and pollutants are directed to minorities and low-incomes interests.” (Oregon DEQ, 1997)

Oregon’s legislature passed Senate Bill 420 “Relating to environmental justice” in 2007, creating a law to require state natural resource agencies to provide greater opportunities for public involvement, in particular for communities and individuals potentially affected by agency actions (Oregon DEQ, 2015i; University of California, Hastings College of Law, 2010). The law established an Environmental Justice Task Force to advise state agencies on environmental justice issues and represent low-income communities, minority communities, and other geographically diverse areas of the state (University of California, Hastings College of Law, 2010). Federal laws relevant to environmental justice are detailed in Section 1.8, Overview of Relevant Federal Laws and Executive Orders.

7.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 7.1.10-1 presents 2013 data on the composition of Oregon’s population by race and by Hispanic origin. The state’s population has lower percentages of individuals who identify as Black/African American (1.8 percent), Asian (3.9 percent), or Some Other Race (2.8 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; for Asian, 10.5 percent and 5.1 percent respectively; and for Some Other Race, 10.0 percent and 4.7 percent respectively.) The state’s population of persons identifying as White (85.8 percent) is considerably larger than that of the West region (68.3 percent) or the nation (73.7 percent).

The percentage of the population in Oregon that identifies as Hispanic (12.3 percent) is considerably smaller than in the West region (31.5 percent), and 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. Oregon’s All Minorities population percentage (22.7 percent) is considerably smaller than that of the West region (51.2 percent) or the nation (37.6 percent).

Table 7.1.10-2 presents the percentage of the population living in poverty in 2013, for the state, region, and nation. The figure for Oregon (16.7 percent) is similar to that of the West region (16.6 percent) and somewhat higher than the figure for the nation (15.8 percent).

Table 7.1.10-1: 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		
Oregon	3,930,065	85.8%	1.8%	1.1%	3.9%	0.4%	2.8%	4.2%	12.3%	22.7%
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, 2015ab)

“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 7.1.10-2: Percentage of Population (Individuals) in Poverty, 2013

Geography	Percent Below Poverty Level
Oregon	16.7%
West Region	16.6%
United States	15.8%

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

7.1.10.4. 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 is readily available at the time of writing.

Figure 7.1.10-1 visually portrays the results of the environmental justice population screening analysis for Oregon. The analysis used block group data from the Census Bureau’s American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015k; U.S. Census Bureau, 2015ad; U.S. Census Bureau, 2015ae; U.S. Census Bureau, 2015af) and Census Bureau urban classification data (U.S. Census Bureau, 2012; U.S. Census Bureau, 2015l).

Figure 7.1.10-1 shows that Oregon has many areas with high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state’s most sparsely populated areas, such as areas east of the Klamath Falls/Altamont area. 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 7.1.10-1 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 7.1.10-1 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 Proposed Actions would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to 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). Section 7.2.10 addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

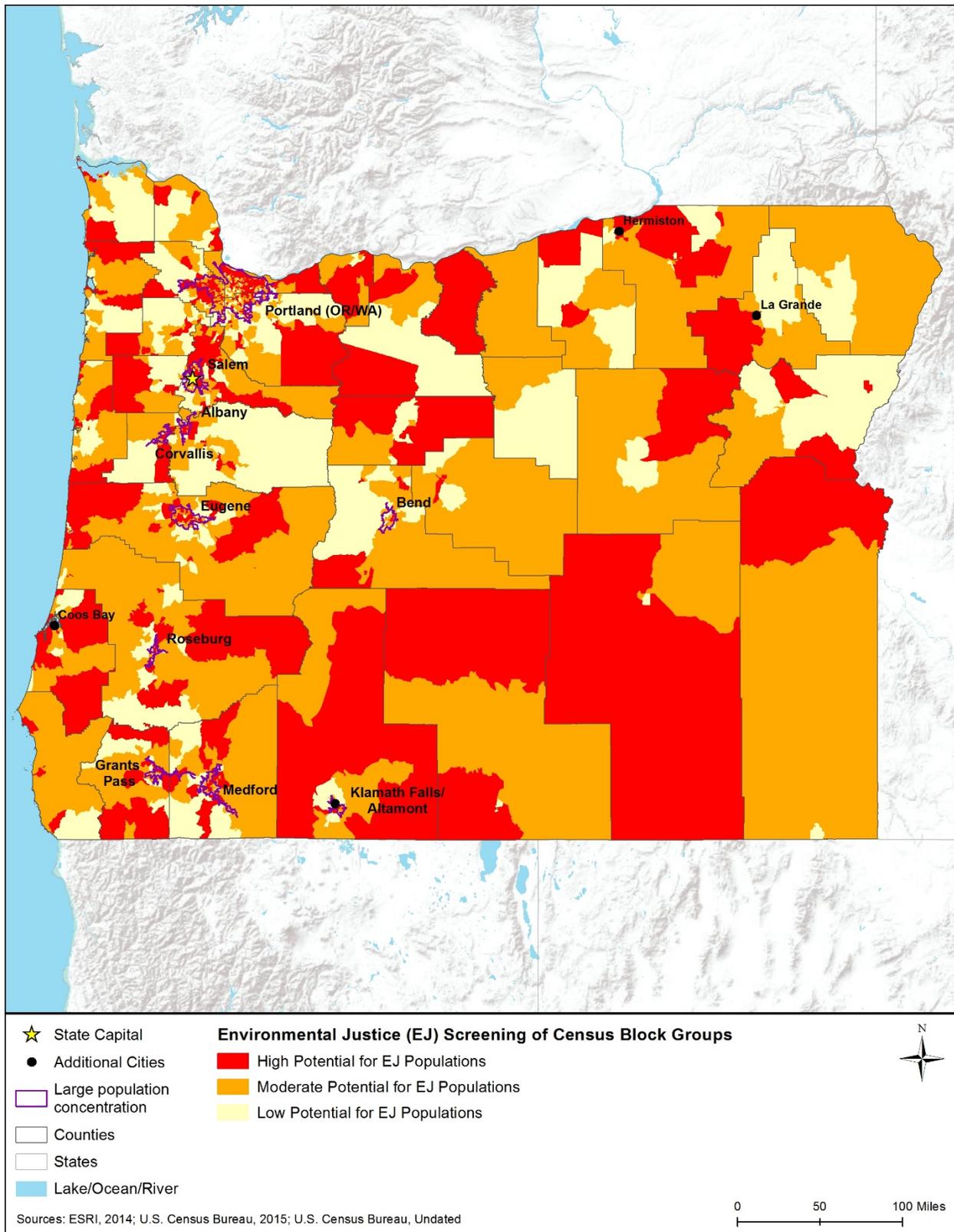


Figure 7.1.10-1: Potential for Environmental Justice Populations in Oregon, 2009–2013

7.1.11. Cultural Resources

7.1.11.1. 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 (NRCS, 2015b); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to American Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004).

7.1.11.2. Specific Regulatory Considerations

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

Oregon has a state law and related regulation that is similar to the NHPA. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations. Table 7.1.11-1 presents state and local laws and regulations that relate to cultural resources.

Table 7.1.11-1: Relevant Oregon Cultural Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
The Oregon State Historic Preservation Act of 1980, Section 14.09	Oregon SHPO	“Requires state agencies to consult with the SHPO if it appears that any projects being planned may or will cause any change, beneficial or adverse, in the quality of any historic, architectural, archeological or cultural property that is listed on the National Register of Historic Places or listed on the State Register or that is determined to be eligible for listing on the State Register.”
State Environmental Quality Review Act (SEQRA)	Oregon Department of Environmental Quality (ODEQ)	“Establishes a set of uniform regulations by which all state, county, and local governmental agencies incorporate consideration of environmental impacts into their planning, review and decision-making processes. Impacts to historic resources, such as buildings listed on the State or National Registers of Historic Places and archeological sites, should be taken into account.”

7.1.11.3. Cultural and Natural Setting

Through the examination of cultural materials, archaeologists have determined that human beings have occupied Oregon for at least 15,000 years, beginning in the Pleistocene epoch. These early people are believed to have crossed the Bering Land Bridge following the migrations of the mammoth, bison, and other large ancestral fauna. Oregon has more than 1,000 archaeological sites, with 131 listed on the National Register of Historic Places (NRHP) (De-Campos, Mamedov, & Huang, 2009).

The indigenous cultural groups identified within Oregon and the adjoining states include the Coos, Lower Umpqua, and Siuslaw, as well as the Coquille people of the Coastal Range, the Umpqua people of southwestern Oregon, and the Grande Ronde community of the Willamette Valley and various regions of western Oregon. Also included in the region are the Klamath, Modoc and Yahooskin of the Klamath Basin, the Siletz of western Oregon (spanning from northern California to southern Washington), and the Cayuse, Umatilla (Umatilla Tribe), Wasco, Paiute and Walla Walla (Warm Springs Tribe) and the Wadatika people (Burns Paiute Tribe) of the Plateau and Great Basin (The Oregon Historical Society, 2015) (National Congress of American Indians, 2016) (State of Oregon, 2015b).

The following sections examine Oregon’s prehistory, which dates from 13,000 B.C. to European colonization in the 1800s. Even after colonization, many American Indians sustained their traditional way of life, and some continue to do so today. Section 7.1.11.4 presents an overview of the initial human habitation in Oregon and the cultural development that occurred before European contact. Section 7.1.11.5 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 7.1.11.6 provides a current list of significant archaeological sites in Oregon and tools that the state has developed to ensure their preservation. Section 7.1.11.7 documents the historic context of the state since European contact, and Section 7.1.11.8 summarizes the architectural context of the state during the historic period.

7.1.11.4. Prehistoric Setting

The aboriginal people of Oregon “gathered a wide variety of plant foods, medicines, and raw materials for household manufacturers; hunted and fished for many kinds of animals; and gathered for social activities, religious observances, trade, and the negotiation of marriages. The distribution over the landscape of natural resources, and the changing seasons, determined the locations and times of many human activities” (Aikens, 1993). Linguistic and cultural diversity were most notable west of the Cascade Mountains, with Athabaskan, Penutian, Salishan, and Shasta language groups represented. Mexican aboriginal traditions are reflected in the Aztec-Tanoan language group of Oregon’s Northern Paiute of the Great Basin region (Aikens, 1993).

Archaeological assemblages in Oregon include, “flaked stone arrow points, knives, scrapers, and drills, or more perishable objects such as antler digging stick handles, sheep horn wrenches, fish traps, and harpoons” (Aikens, 1993). The diversity of language, technology, and lifeways of the aboriginal people of Oregon can be understood in the varying ecologies that were exploited, modified, and eventually settled in by individual groups.

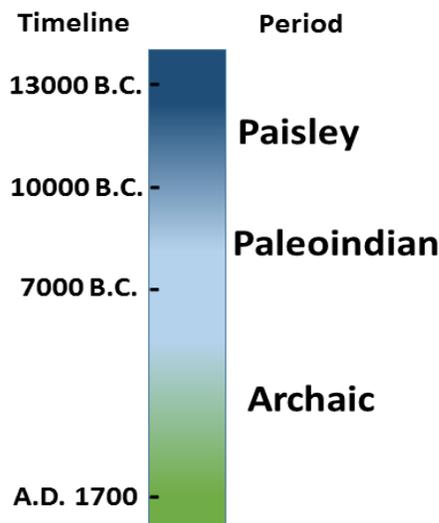


Figure 7.1.11-1: Timeline of Prehistoric Human Occupation

Source: (Institute of Maritime History, 2015)

Paisley Period (13000 - 10000 B.C.)

The Paisley Period occurred during the Pleistocene epoch and the Early Holocene. Big game hunting, particularly the hunting of bison using spear technology with large lanceolate projectile points, was common. Early Paisley Period humans also hunted the remaining North American megafauna, such as the camel, mastodon, and horse, and these events are reflected in the archaeological record. Early seed milling and the opportunistic procurement of fish occurred during this period as well. (Jenkins, Connolly, & Aikens, 2004)

Paleoindian Period (10000 – 7000 B.C.)

The Paleoindian Period for Oregonian natives has been documented by a small number of archaeological studies. The Paleoindian Period spanned approximately 3,000 years during the end of the Pleistocene and is associated with large game hunting and limited flora exploitation. Examples of well-documented sites in Oregon include the Rimrock Draw in southeastern Oregon, Paisley Caves of south-central Oregon, and the Connley Caves in central Oregon. All three sites show evidence of large-game hunting technologies and lifeways focused on exploiting a smaller range of resources as compared with later periods (Archaeological Institute of America, 2015) (University of Oregon, 2015a). Recently discovered evidence at the Rimrock Draw rockshelter has suggested the presence of human occupation in Oregon beginning as early as 13,800 B.C. (BLM, 2015h).

The transition from the Paleoindian Period to the subsequent Archaic Period of aboriginal prehistory of Oregon is marked by a change in lithic technologies. “Earlier fluted Paleoindian point styles undergo a kind of metamorphosis into later nonfluted western stemmed and foliate lanceolate forms” (Bicho, Haws, & Davis, 2011). The Paleoindian Period is marked by (1) the presence of lithic material of varying quality that are locally sourced, (2) diversity in source material, and (3) biface (i.e., projectile point) production that directly transitions from macroblades and macroflakes” (Bicho, Haws, & Davis, 2011).

Fort Rock Sub-Period (10,000 – 6,000 B.C.)

The eruption of Mount Mazama, which resulted in the formation of Oregon’s Crater Lake, in the Cascade Mountain Range, occurred during the Fort Rock Sub-Period of the Paleoindian Period (USGS, 2013d). Both the eruption as well as ongoing climate change had a sharp impact on the ecology of Oregon. As temperatures warmed and dried, shallow water lakes and marshes appeared. Inhabitants of the sub-period hunted the abundant waterfowl, rabbit, pika, and grouse. While the practice of hunting megafauna did not disappear entirely during this period, smaller game species became an increasingly important component of the diet of the regional inhabitants. The Fort Rock Sub-Period is also marked by the expansion of a varied and more sophisticated lifeway, as indicated by a mixture of tools and hunting implements. These included awls, scrapers, milling tools, choppers, sandals, basketry, and leather, as well as lanceolate, Windust, and foliate projectile points (Jenkins, Connolly, & Aikens, 2004).

Archaic Period (7000 B.C. – A.D. 1700)

The Archaic Period in Oregon is marked by new lithic technologies and a wide diversity in lifeways, reflecting the many ecological niches and resources available in the region to the aboriginal people of that time (Bicho, Haws, & Davis, 2011). The continent-wide uniformity of the Clovis horizon gave way to a series of regional cultural patterns as indigenous groups adapted to the various terrains and climatic conditions within the region, including coastal areas, woodlands, deserts, and mountains. While these different “groups were characterized by broad-spectrum hunting and gathering...they differed in detail...reflecting the specific environments to which they adapted” (Aikens, 1993). Collectively, the archaeological record shows that with

varying focus and intensity, the aboriginal people of Oregon hunted large game in colder climates, but also exploited fish, plant, and small game resources when abundant.

Northwest Archaic Period groups living in forested environments used prescribed burning of forests and grasslands (i.e., “pyroculture”) to influence game animal behavior for easier hunting, and to create clearings where valuable flora could grow. During “deer drives,” peripheral fires were set around herds, funneling game animals into selected areas where they could be ambushed. Prescribed burns in the late fall and early winter created large clearings with nutrient rich soils where desirable vegetation could flourish during the spring and summer. This served to attract prey species, which foraged on the understory species, as well as provided a garden where edible plants could be harvested. In the Willamette Valley ecoregion, acorn, blackberry, camas, various types of roots, tobacco, and plants used for basket making were grown. The focus of this technology was similar in the Upper Rogue Ecoregion and Cascade Ecoregion pyro-cultural practices. Aboriginal people of the Coast Ecoregion focused prescribed burning on deer drives. In the Columbia Basin Ecoregion, yarrow, lilies, camas and balsamroot, and sunflower were coveted as important sources of nutrition (Boyd, 1999) (Lewis, 1973).

Although the timelines for Archaic Period prehistory vary by region, a reliable 3-part model has been created for the Northern Great Basin region and is presented below.

Lunette Lake Sub-Period (7000 – 6000 B.C.)

The increased use of obsidian (volcanic glass), a high-quality source material for manufacturing blades and projectile points, and the increase in variety of tool types, marks the Lunette Lake period. The remains of small game, such as waterfowl and rabbit, are associated with this period. The eruption of Mount Mazama had the impact of temporarily reducing the diversity of biota as pyroclastic material (i.e., pumice and ash fall) blanketed the ground and destroyed hundreds of square miles of environment in the surrounding countryside. Homogeneity of prey species and a more localized economy resulted from this major geologic event. The hunting strategies of this period appear to be “risk-sensitive” and “variance minimizing” in response to the remarkable “ecological changes of the Initial Archaic” (Jenkins, Connolly, & Aikens, 2004).

Bergen Sub-Period (6000 – 1000 B.C.)

The first half of the Bergen Sub-Period is marked by a general warming trend, giving way to a cooler, moister period during its second half. The shift to a generally mesic environment brought about a setting that included perennial marshlands. Although Oregon’s indigenous groups adapted to climate change, populations are believed to have trended downwards in correlation with the availability of exploitable marshland resources, such as waterfowl. The native groups of this period are thought to have occupied areas ephemerally, moving on once resources were been depleted to non-sustaining levels. The presence of non-specialized, expedient tools in the archeological record, which is an indicator of a high level of mobility and shift away from a sedentary lifestyle, serves as evidence for this theory. This pattern continued until about 4000 B.C. when villages and permanent habitations began to flourish, apparently as a reflection of increasing ecological stability (Jenkins, Connolly, & Aikens, 2004).

Boulder Village Sub-Period (1000 B.C. – A.D. 1700)

One of the important markers of the Boulder Village Sub-Period is an increase of population density, and sophistication and permanence of dwelling construction techniques. There was also and higher dependence on vegetation for subsistence, specifically roots, although “people continued to rely heavily on lowland resources such as fish, waterfowl, rabbits and small seed crop(s)” (Jenkins, Connolly, & Aikens, 2004).

7.1.11.5. Federally Recognized Tribes of Oregon

According to the National Conference of State Legislators, there are ten federally recognized tribes in Oregon. The location of federally recognized tribes is highlighted in Figure 7.1.11-2. The other tribes depicted on the figure are general locations of tribes that were known to exist in this region of the United States, but are not federally recognized.

Table 7.1.11-2: List of Federally Recognized Tribes of Oregon

Burns Paiute Tribe	Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw	Confederated Tribes of Grande Ronde
Confederated Tribes of Siletz	Confederated Tribes of the Umatilla	Confederated Tribes of Warm Springs
Coquille Indian Tribe	Cow Creek Band of Umpqua Indians	Fort McDermitt Paiute and Shoshone
Klamath Tribes		

Source: (National Conference of State Legislators, 2015)

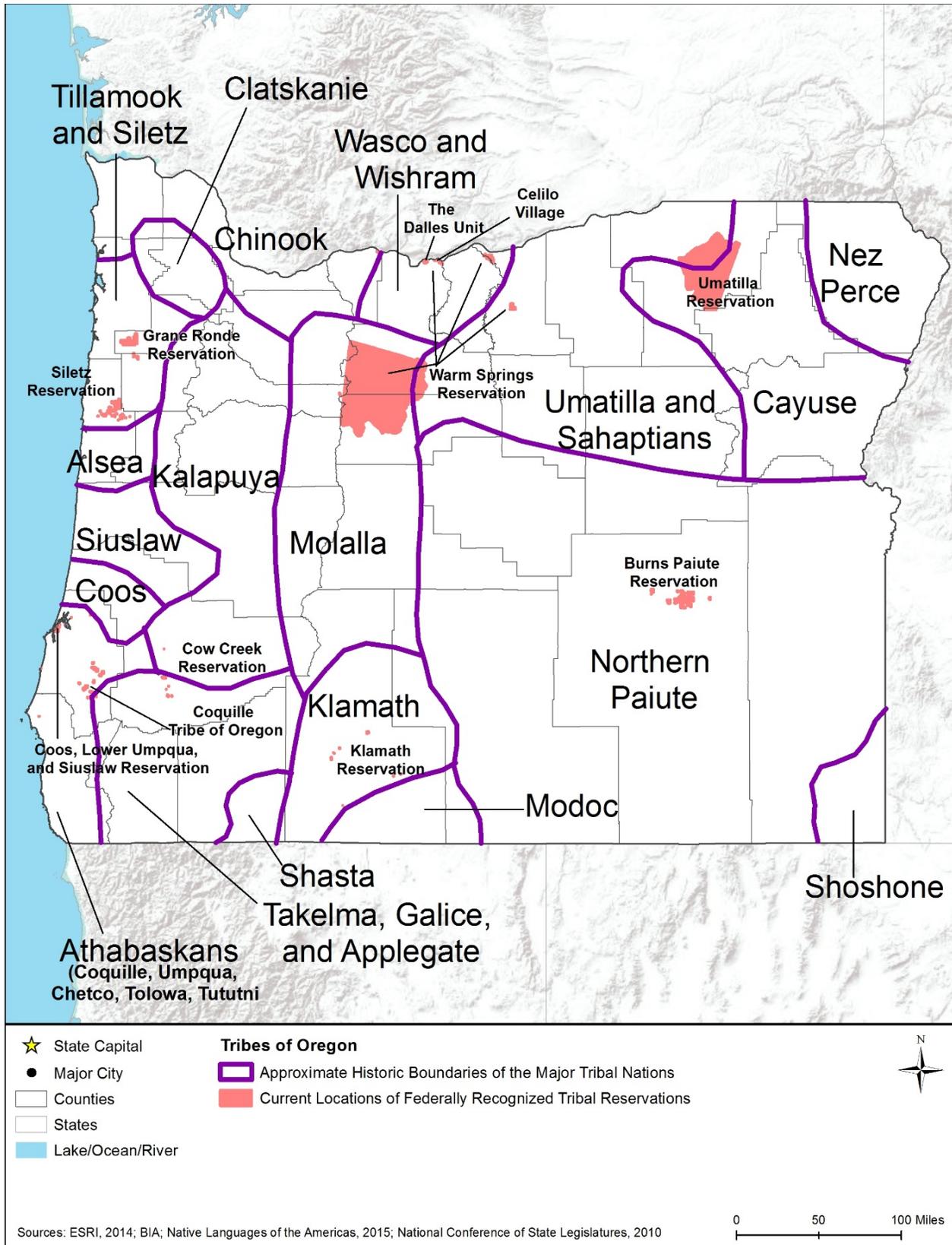


Figure 7.1.11-2: Federally Recognized Tribes in Oregon

7.1.11.6. Significant Archaeological Sites of Oregon

As previously mentioned in Section 7.1.11.3 there are 131 archaeological sites in Oregon listed on the NRHP. Table 7.1.11-3 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites is available on the NPS NRHP website: (<http://www.nps.gov/nr/>) (De-Campos, Mamedov, & Huang, 2009).

Table 7.1.11-3: NRHP Listed Archaeological Sites in Oregon

Closest City	Site Name	Type of Site
Adel	Greaser Petroglyph Site	Prehistoric
Astoria	ISABELLA Shipwreck Site and Remains	Shipwreck
Bandon	Archeological Site (35CS8)	Prehistoric
Bandon	Archeological Site (35CS9)	Prehistoric
Bandon	Bullards Beach Site	Historic - Aboriginal, Prehistoric
Bandon	Philpott Site (35CS1)	Prehistoric
Bandon	Running Foxe Midden (35CS131)	Prehistoric
Brookings	Archeological Site (35CU79)	Prehistoric
Brookings	Archeological Site (35CU80)	Prehistoric
Brookings	Harris Park Mound	Prehistoric
Brookings	Indian Sands	Prehistoric
Brookings	Lone Ranch Creek Mound	Prehistoric
Brothers	Pictograph Site	Prehistoric
Cannon Beach	Bald Point Site (35CLT23)	Prehistoric
Cannon Beach	Ecola Point Site (35CLT21)	Historic - Aboriginal, Prehistoric
Cannon Beach	Indian Creek Village Site (35CLT12)	Historic - Aboriginal, Prehistoric
Carpenterville	High Point Shell Midden (35CU215)	Prehistoric
Carpenterville	Arch Rock	Prehistoric
Carpenterville	Archeological Site (35CU69)	Prehistoric
Carpenterville	Indian Sands	Prehistoric
Carpenterville	Khustenete–Hustenete–Xusteneten	Historic - Aboriginal, Prehistoric
Carpenterville	Miller Creek	Prehistoric
Carpenterville	Sheep Trail Shell Midden (35CU32)	Prehistoric
Carpenterville	Thunder Rock	Prehistoric
Carpenterville	Whale Head	Historic - Aboriginal, Prehistoric
Carpenterville	Whaleshead Lithic Site (35CU207)	Prehistoric
Carpenterville	Whaleshead South Midden (35CU208)	Prehistoric
Carpenterville	Whaleshead Trail Viewpoint (35CU36)	Prehistoric
Cascadia	Cascadia Cave	Prehistoric
Central Point	Fort Lane Military Post Site	Military
Charleston	Archeological Site (35CS129)	Prehistoric
Charleston	Archeological Site (35CS39)	Prehistoric

Closest City	Site Name	Type of Site
Charleston	Archeological Site (35CS66)	Prehistoric
Charleston	Archeological Site (35CS67)	Prehistoric
Charleston	Cape Arago Site (35CS10)	Prehistoric
Charleston	Mussell Reef Village	Historic - Aboriginal, Prehistoric
Charleston	Samuels Site (35CS138)	Prehistoric
Depoe Bay	Archeological Site (35LNC68)	Prehistoric
Depoe Bay	Boiler Bay Site (35LNC45)	Prehistoric
Depoe Bay	Government Point Site	Prehistoric
Depoe Bay	Rocky Creek Site (35LNC43)	Prehistoric
Eugene	Flanagan Site (35LA218)	Prehistoric
Fort Klamath	Fort Klamath Site	Historic, Military
Fort Rock	Fort Rock Cave	Prehistoric
Gardiner	Tahkenitch Landing Site (35DO130)	Prehistoric
Glide	Susan Creek Indian Mounds Site	Prehistoric
Grass Valley	Mack Canyon Archeological Site	Historic - Aboriginal, Prehistoric
Kings Valley	Fort Hoskins Site	Historic, Military
Knappa	Hlilusqahih Site (35CLT37)	Historic - Aboriginal
Lakeview	Abert Lake Petroglyphs	Prehistoric
Manzanita	Cronin Point Site (35TI4)	Prehistoric
Manzanita	Spruce Tree Site (35TI75)	Historic, Historic - Aboriginal, Prehistoric
Manzanita	North Trail House Site (35TI76)	Historic - Aboriginal
Manzanita	Nehalem Boat Ramp Midden (35TI62)	Prehistoric
Mosier	Mosier Mounds Complex	Historic - Aboriginal, Prehistoric
Neahkahnie	Smuggler Cove Shell Midden (35TI46)	Historic - Aboriginal, Prehistoric
Nehalem	Nehalem Bay Dune Site	Prehistoric
Netarts	Archeological Site (35TI39)	Historic - Aboriginal, Prehistoric
Netarts	Archeological Site (35TI1)	Historic - Aboriginal, Prehistoric
Netarts	Archeological site (35TI36)	Prehistoric
Netarts	Archeological site (35TI38)	Historic - Aboriginal, Prehistoric
Netarts	Archeological Site (35TI40)	Historic - Aboriginal, Prehistoric
Netarts	Archeological Site (35TI44)	Historic - Aboriginal, Prehistoric
Netarts	Archeological Site (35TI45)	Historic - Aboriginal, Prehistoric
Netarts	Archeological Site (35TI54)	Prehistoric
Netarts	Cape Canyon Midden (35TI61)	Historic - Aboriginal, Prehistoric
Netarts	Cove Creek Midden (35TI35)	Historic - Aboriginal, Prehistoric
Netarts	Netarts FCR Camp (35TI67)	Historic - Aboriginal, Prehistoric
Netarts	Netarts Marsh Site (35TI68)	Historic - Aboriginal, Prehistoric
Netarts	Netarts Spit FCR--Elko Site (35TI65)	Historic - Aboriginal, Prehistoric
Netarts	Netarts Spit Lithic Site	Historic - Aboriginal, Prehistoric
Newberg	Despard, Joseph, Cabin Site	Historic

Closest City	Site Name	Type of Site
Newberg	Hudson's Bay Company Granary and Clerk's House Site	Historic
Newberg	Young, Ewing, Site	Historic
North Bend	The Osprey Site (35CS130)	Historic - Aboriginal, Prehistoric
North Bend	Archeological Site (35CS24)	Prehistoric
Oceanside	Oceanside Site (35TI47)	Prehistoric
Otter Rock	Devil's Punch Bowl	Prehistoric
Pistol River	Archeological Site (35CU31)	Prehistoric
Pistol River	Eagle Rock	Prehistoric
Pistol River	Little Ridge--Cape Sebastian (35CU77)	Prehistoric
Pistol River	Little Ridge--Cape Sebastian (35CU78)	Prehistoric
Pistol River	Pistol River Site--Chetlessentan--Chetleshin--Chetless-chun-dunn	Historic - Aboriginal, Prehistoric
Port Orford	Archeological Site (35CU13)	Prehistoric
Port Orford	Archeological Site (35CU14)	Prehistoric
Port Orford	Archeological Site (35CU142)	Prehistoric
Port Orford	Archeological Site (35CU153)	Prehistoric
Port Orford	Archeological Site (35CU16)	Prehistoric
Port Orford	Blacklock Point Lithic Site	Prehistoric
Port Orford	Blacklock Point Shell Midden	Historic
Port Orford	Cape Blanco Lithic Site	Prehistoric
Port Orford	Port Orford Site	Prehistoric
Portland	Sunken Village Archeological Site (35MU4)	Prehistoric
Reedsport	Umpqua--Eden Site	Prehistoric
Seal Rock	Seal Rock	Historic, Historic - Aboriginal, Prehistoric
Searose Beach	Archeological site (35LA1)	Prehistoric
Searose Beach	Archeological Site (35LA11)	Prehistoric
Searose Beach	Archeological Site (35LA13)	Prehistoric
Searose Beach	Archeological Site (35LA16)	Prehistoric
Searose Beach	Archeological site (35LA2)	Prehistoric
Searose Beach	Archeological Site (35LA227)	Prehistoric
Searose Beach	Archeological site (35LA228)	Prehistoric
Searose Beach	Archeological site (35LA4)	Prehistoric
Searose Beach	Archeological site (35LA5)	Prehistoric
Searose Beach	Archeological site (35LA6)	Prehistoric
Searose Beach	Archeological site (35LA7)	Prehistoric
Searose Beach	Bob Creek Site (35LA10)	Prehistoric
Searose Beach	Devil's Elbow Site (35LA17)	Historic - Aboriginal, Prehistoric
Searose Beach	Neptune Site (35LA3)	Historic - Aboriginal, Prehistoric
Searose Beach	Strawberry Hill Site (35LA8)	Prehistoric
Silver Lake	Picture Rock Pass Petroglyphs Site	Prehistoric
Sixes	Archeological Site (35CU1)	Prehistoric

Closest City	Site Name	Type of Site
Sixes	Archeological Site (35CU83)	Prehistoric
Sixes	Newburgh Lithic Site (35CU209)	Prehistoric
St. Paul	Champoeg State Park Historic Archeological District	Historic - Aboriginal
Svensen	Indian Point Site (35CLT34)	Historic, Historic - Aboriginal, Prehistoric
The Dalles	Fivemile Rapids Site (35WS4)	Prehistoric
Toledo	The Ahnkuti Site (35LNC76)	Historic - Aboriginal, Prehistoric
Umatilla	Umatilla Site (35UM1)	Historic, Historic - Aboriginal, Prehistoric
Valley Falls	East Lake Abert Archeological District	Prehistoric
Willamina	Fort Yamhill Site	Military
Yachats	Archeological Site (35LNC48)	Historic - Aboriginal, Prehistoric
Yachats	Archeological Site (35LNC63)	Prehistoric
Yachats	Archeological Site (35LNC54)	Prehistoric
Yachats	Archeological Site (35LNC55)	Prehistoric
Yachats	Archeological Site (35LNC56)	Prehistoric
Yachats	Archeological Site (35LNC57)	Prehistoric
Yachats	North 804 Midden (35LNC72)	Historic - Aboriginal
Yachats	Smelt Sands Midden (35LNC65)	Historic - Aboriginal, Prehistoric
Yachats	Trail 804 Midden #3 (35LNC73)	Prehistoric
Yachats	Yachats Trail 804 Midden (35LNC66)	Prehistoric

Source: (De-Campos, Mamedov, & Huang, 2009)

Oregon State Cultural Resources Database and Tools

Oregon State Historic Preservation Office (SHPO)

The Oregon State Historic Preservation Office administers programs for the state's archaeological and historic resources. The office is responsible for regulatory oversight of archaeological activities, overseeing preservation programs, maintaining archaeological and historical resources, and encouraging culturally sustainable economic development. A list of all NRHP nominations is available on the SHPO website (<http://www.oregon.gov/oprd/HCD/SHPO/Pages/index.aspx>) for review, as well as nomination forms and documents (OPRD 2016c).

Oregon Archaeological Society

The Oregon Archaeological Society holds monthly and annual seminars on the archaeology of the Northwest where people can learn and share about the cultural resources and research methodologies of the region. Information about becoming an affiliate of the Oregon Archaeological Society is available at (www.oregonarchaeological.org/) (Archaeological Institute of America, 2015).

7.1.11.7. *Historic Context*

Beginning in the mid-16th century, and continuing during the 17th and early 18th centuries, European explorers are believed to have ventured into present-day Oregon, including the English explorer and privateer Sir Francis Drake in 1579. Starting in the late 18th century, the fur trading industry took root and began to grow, aided by increasing exploration of the Columbia River. In May 1792, the American merchant ship captain Robert Gray became the first European-American to explore what became named the Columbia River after his vessel, *Columbia Rediviva*. In 1805, Lewis and Clark followed the Columbia River to the Pacific Ocean during their exploration of the Louisiana Purchase.¹¹⁶ Lewis and Clark wintered in Oregon from 1805 to 1806, establishing Fort Clatsop as their winter encampment; Fort Clatsop did not become a permanent settlement (Oregon Public Health Division, 2015a).

In 1811, John Jacob Astor's Pacific Fur Company established Fort Astoria at the mouth of the Columbia River. Control of Fort Astoria transitioned to the Canadian North West Company, who bought out the Pacific Fur Company's interests in 1813 after the onset of the War of 1812, and Fort Astoria was renamed Fort George. Astoria is considered the first American-established settlement on the west coast. Additional fur trading outposts were established during the early 19th century, and in 1818, the United States and England agreed to jointly occupy Oregon. The lumber industry began to grow as well, starting in the 1820s. As the 19th century progressed, territorial settlements began to increase in size and permanence, with Portland, Vancouver (now in Canada), and Seattle (now in Washington) being examples. Growth was aided by the Oregon Trail, which served as a pipeline for immigration during the 19th century. In 1848, the Oregon Territory was created and initially included present-day Oregon, Washington, and Idaho, as well as portions of Montana and Wyoming (Oregon Public Health Division, 2015a).

On February 14, 1859, Oregon joined the Union as the 33rd state. While no activity associated with the Civil War occurred in Oregon, forts were constructed in the area as a means of protecting settlers. Gold was discovered in the 1850s and mining activity continued through the 1870s, with a major discovery occurring in the Blue Mountains in the northeast region of the state in the 1860s. Conflict with the indigenous population continued into the late 19th century, with boarding schools being established with the goal of assimilating American Indian children into western culture; a boarding school in Forest Grove, which became the state's first incorporated city in 1872, was opened in 1879. The railroad arrived in the late 19th century as well, which ultimately led to a decline in wagon traffic on the Oregon Trail. The railroad aided in the growth of Oregon's timber and agricultural industries (Oregon Public Health Division, 2015b).

Oregon men and women contributed to the war effort as a part of both World War I (WWI) and World War II (WWII). During WWII, Japanese residents were forcibly removed from their homes and placed in internment camps for fear of their possible association with Japan. Both the Army and Navy established military bases in Oregon during WWII, including Camp Adair and

¹¹⁶ Present day Oregon was not acquired through the Louisiana Purchase.

Camp Abbot, which were U.S. Army training facilities that existed only during WWII and were closed immediately afterwards (Oregon BCD, 2015).

Oregon has 2,009 National Register of Historic Places (NRHP) listed sites, as well as 17 NHL (NPS, 2014f). Oregon does not contain a National Heritage Area (NHA) (NRCS, 2015c). Oregon contains four State Heritage Areas and nine State Heritage Sites (OPRD, 2016a). Figure 7.1.11-3 shows the location of NRHP sites within the state of Oregon.¹¹⁷

7.1.11.8. Architectural Context

Early European and Anglo-American settlements in Oregon developed around the fur trading industry in the late 18th century. Lewis and Clark's log-built Fort Clatsop (1805) is one notable early encampment that has been reconstructed for historic interpretation (Vaughan, 1974). Fort Astoria, founded by John Jacob Astor's Pacific Fur Company in 1811, was the first permanent U.S. settlement on the west coast. Early structures were built of logs, with more elaborate wood-framed dwellings being constructed as settlements developed. Vertical wood plank construction was also implemented (Ross, M., 1956). Wood construction was a sensible choice due to Oregon's abundant supply of timber, and the method of construction often varied based on the craft and heritage of the builder (Vaughan, 1974).

Some early formal architecture in Oregon was inspired by the Classical Revival movement and included Federal and Greek Revival buildings. The Dr. John McLoughlin House (1845 to 1846) and the Forbes Barclay House (1850), adjacent to each other in Oregon City, exhibit popular stylistic and design principles from the time. Villa style buildings, along with Gothic Revival buildings, followed during the mid-19th century and fit well with Oregon's naturalistic setting. The A.V. Peters House in Eugene is an example of a modest Gothic Revival cottage that is representative of what would have been commonly built (Ross, 1959). As railroad transport provided many people with modern building materials like cast iron, steel, and milled lumber, the size and appearance of buildings changed (Ross, M., 1956). Victorian styles like Italianate and Second Empire were common, with Italianate building exhibiting heavy bracketing along cornices and being especially common in commercial architecture. Early skyscrapers emerged in the commercial areas of Portland and other larger cities, exhibiting decorative cornice lines and Neoclassical elements. Queen Anne, Stick, and other late-Victorian styles were common for residences leading up to the turn of the 20th century (Ross, 1959).

Early 20th century commercial buildings exhibited Neoclassical stylings, while bungalows with Craftsman stylings were common in residential architecture. Bungalows, Prairie houses, and Foursquares were built up through WWII, while Modernism grew in popularity in the decades after WWI. The A.R. Watzek House, built between 1936 and 1938, is a notable example of Modern architecture. The International style, Art Deco, Art Moderne, and Streamline Modern are a few examples of popular Modern styles that were built during the first half of the 20th century (Ross, 1959).

¹¹⁷ See Section 7.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

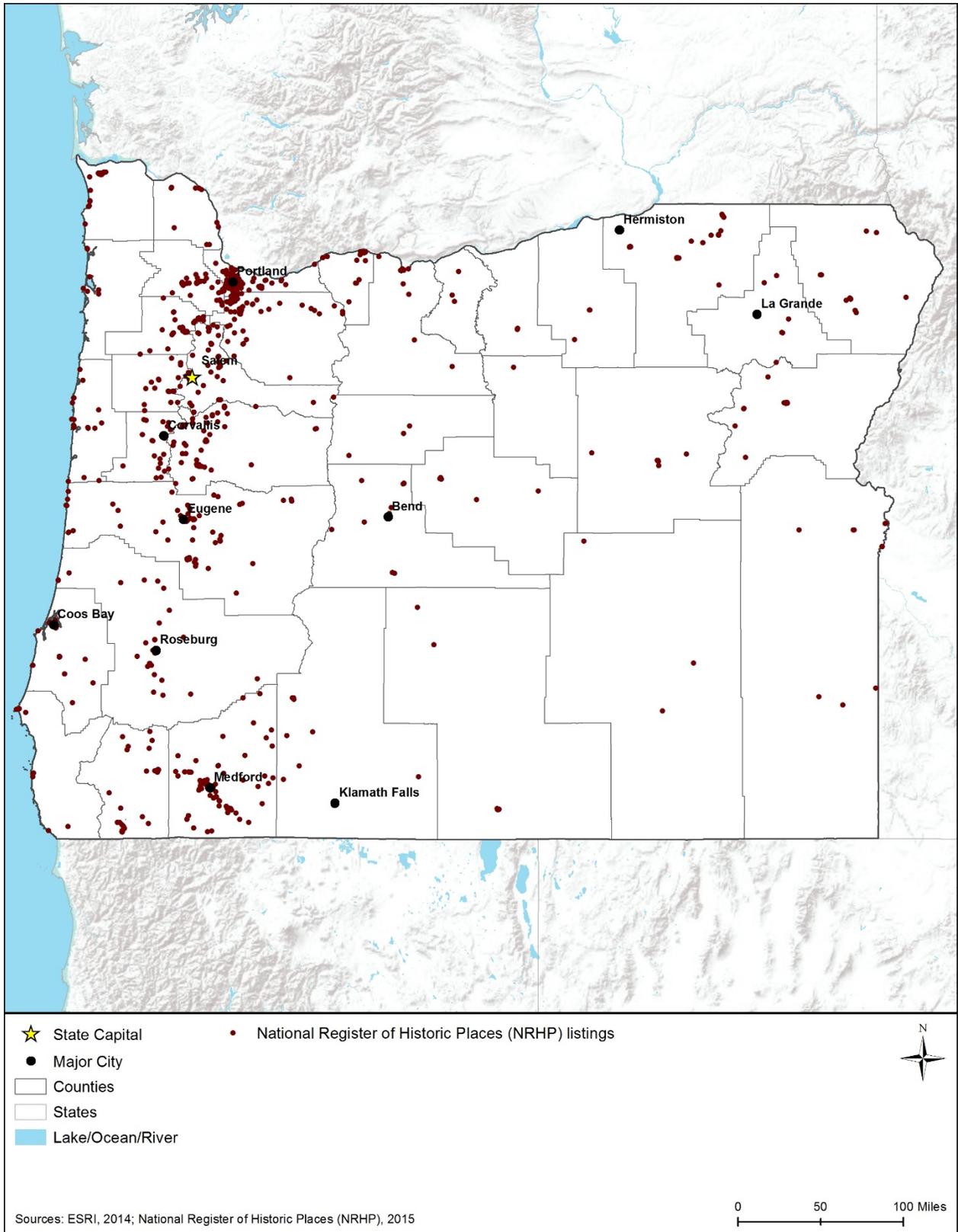


Figure 7.1.11-3: National Register of Historic Places (NRHP) Sites in Oregon

Many churches were built in the mid-to-late 19th century as settlements developed, with many of these structures exhibiting Gothic Revival traits, which remained popular into the 20th century. The First Presbyterian Church of Portland (1890) is an example of High Victorian Gothic architecture. Civic, institutional, and public buildings were constructed in great numbers starting in the late 19th century as settlements grew in size. These included post offices, jails, courthouses, train stations, and educational facilities. The educational facilities ranged from one-room schoolhouses to large university buildings. The styles of these buildings commonly followed popular trends (Ross, 1959). The University of Oregon (1876) is an example of a large public educational facility that contains numerous historic buildings (University of Oregon, 2015b). Figure 7.1.11-4 shows examples architectural styles in Oregon.



Figure 7.1.11-4: Representative Architectural Styles of Oregon

- Top Left – William Parker House (Gervais, OR) – (Historic American Buildings Survey, 1933a)
- Bottom Left – U.S. Courthouse (Portland, OR) – (Historic American Buildings Survey, 1933b)
- Top Right – Goodbye Creek Bridge (Klamath Falls, OR) – (Historic American Engineering Record, 1968a)
- Middle Right – Pioneer Post Office (Portland, OR) – (Historic American Buildings Survey, 1933c)
- Bottom Right – Short Bridge (Cascadia, OR) – (Historic American Engineering Record, 1968b)

7.1.12. Air Quality

7.1.12.1. Definition of the Resource

The type determines air quality in a geographic area and amount of pollutants emitted into the atmosphere, the size, and topography¹¹⁸ 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)¹¹⁹ or micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) determined over various periods of time (averaging time).¹²⁰ This section discusses the existing air quality in Oregon. USEPA designates areas within the United States as attainment,¹²¹ nonattainment,¹²² maintenance,¹²³ or unclassifiable¹²⁴ 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.

Oregon DEQ is responsible for enforcing federal, state air quality regulations covering the entire state with exception of Lane County. The Lane Regional Air Protection Authority (LRAPA) is a separate and distinct air regulatory authority that enforces federal, state, and local air quality regulations for Lane County. LRAPA maintains its own air regulations, state implementation plan (SIP), and ambient air quality standards. LRAPA incorporates many of Oregon DEQ regulations by reference and permitting forms.

7.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide (CO), lead, oxides of nitrogen (NO_x), particulate matter ($\text{PM}_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_x). The NAAQS establish various standards, either primary¹²⁵ or secondary,¹²⁶ for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer

¹¹⁸ Topography: The unique features and shapes of the land (e.g., valleys and mountains).

¹¹⁹ Equivalent to 1 milligram per liter (mg/L).

¹²⁰ 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 2015t).

¹²¹ Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA 2015u).

¹²² 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 2015u).

¹²³ 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 2015u).

¹²⁴ 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 2015u).

¹²⁵ 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, 2014c).

¹²⁶ 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, 2014c).

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.

In conjunction with the federal NAAQS, Oregon maintains its own air quality standards, the Oregon Ambient Air Quality Standards (OR AAQS). Oregon Table 7.1.12-1 presents an overview of the OR AAQS as defined by Oregon DEQ.

Table 7.1.12-1: Oregon Ambient Air Quality Standards (OR AAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m ³	ppm	µg/m ³	ppm	
CO	8-hour	-	9	-	-	Standard is not to be exceeded more than once per year
	1-hour	-	35	-	-	Standard is not to be exceeded more than once per year
Lead	3-month	0.15	-	-	-	Rolling average. Not to be exceeded
NO ₂	1-hour	-	0.100	-	-	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Annual	-	0.053	Same as Primary		Average concentration, must not be exceeded more than once per calendar year at any site
PM ₁₀	24-hour	150	-	-	-	Not to be exceeded at more than once at any site.
PM _{2.5}	Annual	15	-	-	-	Annual mean, averaged over 3 years
	24-hour	35	-	-	-	98th percentile, averaged over 3 years
O ₃	8-hour	-	0.075	-	-	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
SO ₂	1-hour	-	0.075	-	-	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	3-hour	-	0.50	-	-	Not to be exceeded more than once per year
	24-hour	-	0.10	-	-	Average concentration, must not be exceeded more than once per calendar year at any site
	Annual	-	0.02	-	-	Annual arithmetic mean for any calendar year
Particle Fallout	1-Month	10 g/m ²		-	-	Must not exceed in an industrial area
	1-Month	5 g/m ²		-	-	Must not exceed in an industrial area if visual observations show presence of wood waste or soot and volatile fraction of the sample exceeds 70%
	1-Month	5 g/m ²		-	-	Must not exceed in a residential and commercial area

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		µg/m ³	ppm	µg/m ³	ppm	
	1-Month	3.5 g/m ²		-	-	Must not exceed in a residential and commercial area if visual observations show presence of wood waste or soot and volatile fraction of the sample exceeds 70%

Source: (Oregon DEQ, 2015j)

Title V Operating Permits/State Operating Permits

Oregon 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, 2015f). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015g). Oregon Administrative Code (OAR) Division 218 (Oregon Title V Operating Permits) describes the applicability of Title V operating permits. Oregon 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 7.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014a).

Table 7.1.12-2: Major Air Pollutant Source Thresholds

Pollutant	TPY
Any Criteria Pollutant ^a	100
Single HAP	10
Total/Cumulative HAPs	25

Source: (USEPA, 2014b)

^aSources in nonattainment areas will have lower thresholds for some criteria pollutants depending on the classification of the nonattainment area.

In addition to Title V operating permits, Oregon DEQ has six types of Air Contaminant Discharge Permits (ACDP). ACDPs are primarily used to regulate minor sources of air emissions, however are required for any new or modified major source. The six types of ACDPs are Short Term Activity, Basic, General, Simple, Standard, and Construction. A General ACDP is issued for an entire source category, while the other types of ACDPs are for an individual facility.

Exempt Activities

Oregon DEQ does not explicitly exempt any source from obtaining a permit; however, stationary sources that are not a major source (see Table 7.1.12-2) are not required to obtain a Title V permit. All activities should review applicable stationary source requirements, or contact the Oregon DEQ for additional assistance. (Oregon DEQ, 2015k)

Temporary Emissions Sources Permits

Under OAR 340-218-0100 (Temporary Sources), the Oregon DEQ may issue a single permit for similar sources that are utilized by the same owner and operated at multiple facilities for the same purpose. The operations must be temporary and move at least once during the length of the permit. An affected source¹²⁷ cannot obtain a temporary permit (Oregon DEQ, 2015k).

State Preconstruction Permits

Oregon DEQ requires specific sources to submit notification prior to construction or modification of an emissions source under OAR 340-210-0205 (Notice of Construction and Approval of Plans) and obtain a Notice of Construction and Approval of Plans (NOC/AOP). Sources that are newly constructed or modified that are required to obtain a Title V operating permit or an ACDP must obtain a NOC/AOP. In addition, any source that uses an air pollution control devices to avoid permitting and comply with emissions limits must obtain an NOC/AOP (Oregon DEQ, 2015l).

The NOC/APO does not apply to portable sources that do not have a current permit and categorically insignificant activities, unless they are subject to NESHAP or NSPS requirements. “This exemption applies to all categorically insignificant activities whether or not they are located at major or non-major sources.” (Oregon DEQ, 2015l).

Categorically insignificant activities include the following:

- “...Distillate oil, kerosene, gasoline, natural gas or propane burning equipment brought on site for six months or less for maintenance, construction or similar purposes, such as but not limited to generators, pumps, hot water pressure washers and space heaters, provided that any such equipment that performs the same function as the permanent equipment, must be operated within the source’s existing PSEL...”
- ...Temporary construction activities...
- ...Paved roads and paved parking lots within an urban growth boundary...
- ...Health, safety, and emergency response activities...
- ...Emergency generators and pumps used only during loss of primary equipment or utility service due to circumstances beyond the reasonable control of the owner or operator, or to address a power emergency, provided that the aggregate horsepower rating of all stationary emergency generator and pump engines is not more than 3,000 horsepower. If the aggregate horsepower rating of all stationary emergency generator and pump engines is more than 3,000 horsepower, then no emergency generators and pumps at the source may be considered categorically insignificant...” (Oregon DEQ 2015s)

¹²⁷ An affected source is a source that includes one or more “units that are subject to emission reduction requirements or limitations under Title IV of the FCAA” (Oregon DEQ 2015s).

Registration Requirements and Indirect Source Construction Permit

OAR 340-210-0100 (Registration) states that air contaminate¹²⁸ sources that are required to obtain an ACDP or Title V operating permitting must register the source with the Oregon DEQ. (Oregon DEQ, 2015l)

In addition, Indirect Sources¹²⁹ must not start construction without an approved Indirect Source Construction Permit (ISCP) issued by the Oregon DEQ. Sources that meet specific type, location, size, and operations are required to apply for an ISCP. Specifically sources that are “located within the boundaries of a Carbon Monoxide nonattainment area or maintenance area identified in the State Implementation Plan, provided that such areas include at least one city containing 50,000 or more Population within the city’s municipal boundary, including but not limited to Portland, Salem, Medford and Eugene” must apply for an ISCP (Oregon DEQ, 2015m).

General Conformity

Established under Section 176(c)(4) of the CAA, the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state’s plans to meet national standards for air quality outlined in the state implementation plan (SIP) (USEPA, 2013b). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), Federal actions “in response to emergencies which are typically commenced on the order of hours or days after the emergency” and actions “which are part of 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 (U.S. GPO, 2010).

The estimated pollutant emissions are compared to *de minimis*¹³⁰ levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 7.1.12-3). As a result, lower *de minimis* thresholds for VOCs and NO_x could apply depending on the attainment status of a county.

If an action does not result in an emissions increase above the *de minimis* levels in Table 7.1.12-3, then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 7.1.12-3, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a

¹²⁸ Air Containment is “a dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon, acid, particulate matter, regulated pollutant, or any combination thereof” (Oregon DEQ 2015s).

¹²⁹ Indirect Sources is “a facility, building, structure, or installation, or any portion or combination thereof, which indirectly causes or may cause Mobile Source activity that results in emissions of an air contaminant for which there is a National Ambient Air Quality Standard” (Oregon DEQ, 2015m).

¹³⁰ *de minimis*: USEPA states that “40 CFR 93 § 153 defines *de minimis* levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas.” (USEPA, 2016e)

new violation of the NAAQS. To demonstrate conformity¹³¹, 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).

Table 7.1.12-3: *De Minimis* Levels

Pollutant	Area Type	TPY
Ozone (VOC or NO _x)	Serious Nonattainment	50
	Severe Nonattainment	25
	Extreme Nonattainment	10
	Other areas outside an OTR	100
Ozone (NO _x)	Maintenance	100
Ozone (VOC)	Maintenance outside an OTR	100
CO, SO ₂ , NO ₂	All Nonattainment and Maintenance	100
PM ₁₀	Serious Nonattainment	70
	Moderate Nonattainment and Maintenance	100
PM _{2.5} (Direct Emissions) (SO ₂) (NO _x (unless determined not to be a significant precursor)) (VOC or ammonia (if determined to be significant precursors))	All Nonattainment and Maintenance	100
Lead	All Nonattainment and Maintenance	25

Source: (U.S. GPO, 2010)

State Implementation Plan Requirements

The Oregon SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Oregon’s SIP is a conglomeration of separate actions taken for each of the pollutants. All of Oregon’s SIP actions are codified under 40 CFR Part 52 Subpart MM. A list of all SIP actions for all six criteria pollutants can be found on USEPA’s website (USEPA, 2016c).

¹³¹ Conformity: Compliance with the State Implementation Plan.

7.1.12.3. Specific Regulatory Considerations for the Lane Regional Air Protection Authority (LRAPA)

National and State Ambient Air Quality Standards

The LRAPA monitors and regulates Lane County air quality. In conjunction with the federal NAAQS, LRAPA maintains its own air quality standards as defined by the LRAPA Regulations Part 3 (Ambient Air Quality Standards). These AAQS are the same as the OR AAQS (see Table 7.1.12-1), with the exception of the 8-hour O₃ which is 0.08ppm instead of 0.075ppm and there are no regulations for 1-hour SO_x and NO_x (LRAPA, 2011a).

Title V Operating Permits/State Operating Permits

LRAPA 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, 2013c). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2015f). LRAPA refers to OAR Division 218 (Oregon Title V Operating Permits) in LRAPA Section 31-180 (Rules Applicable to Sources Required to Have Title V Operating Permits, Authority to Implement) to describe the applicability of Title V operating permits. LRAPA regulations require 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 7.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014b).

In addition to Title V operating permits, LRAPA has seven types of Air Contaminant Discharge Permits (ACDP). ACDPs are primarily used to regulate minor sources of air emissions, however are required for any new or modified major source. The seven types of ACDPs are Basic, Simple, Standard, and General Permits 1-5. LRAPA issues the seven types of ACDP’s based on type of activity, size, and location.

Exempt Activities

LRAPA Section 12-020 (Exceptions) does not explicitly exempt any source from obtaining a permit; however, stationary sources that are not a major source (see Table 7.1.12-2) are not required to obtain a Title V permit. All activities should review applicable stationary source requirements, or contact LRAPA for additional assistance. (LRAPA, 2011b)

Temporary Emissions Sources Permits

Temporary emissions sources¹³² are required to obtain permits as per stationary source guidelines. Temporary sources must follow the Best Available Control Technology (for maintenance and PDS areas) and Lowest Achievable Emission Rate (for nonattainment areas).

¹³² Temporary emissions sources are sources that will not be in operation longer than 2 years. Examples of temporary emissions sources are portable facilities, and emissions resulting from the construction phase of a new source or modification. (LRAPA, 2011b)

LRAPA Section 38-0080 (exemptions) exempts temporary emission sources from additional requirements such as obtaining offsets, conducting air quality impact analysis, and conducting air quality monitoring (LRAPA, 2011c).

Preconstruction Permits

LRAPA Regulation 34-034 (Requirements for Construction) requires persons planning to construct or modify a stationary source (which will increase any regulated pollutant emissions) and persons planning to construct or modify air pollution control equipment to notify LRAPA in writing of the intended activities. (LRAPA, 2011d)

LRAPA Title 34 (Stationary Source Notification Requirements) 34-010 and 34-034 through 34-038 (all requirements with exception to the construction requirements) does not apply to categorically insignificant activities that are not subject to NESHAP or NSPS requirements. “This exemption applies to all categorically insignificant activities whether or not they are located at major or non-major sources.” (LRAPA, 2011d) Categorically insignificant activities are as follows:

- “...distillate oil, kerosene, and gasoline fuel burning equipment rated at less than or equal to 0.4 million Btu/hr;
- natural gas and propane burning equipment rated at less than or equal to 2.0 million Btu/hr...
- ...temporary construction activities...
- ...emergency generators and pumps used only during loss of primary equipment or utility service due to circumstances beyond the reasonable control of the owner or operator, or to address a power emergency as determined by LRAPA or the Department [Oregon DEQ]...” (LRAPA, 2011b)

Fugitive Dust Emissions

LRAPA Section 48-015 (Rules for Fugitive Emissions, General Requirements) indicates that any activities that could potentially result with particulate matter to become airborne must take sufficient precautions. Examples of such precautions include, but are not limited to, using water for dust control, cover beds of trucks moving materials that could become airborne, and remove any accumulated dirt (or other airborne materials) from paved streets. (LRAPA, 2008)

Registration Requirements and Indirect Source Construction Permit

LRAPA Section 34-025 (Registration in General) indicates that air contaminate¹³³ sources that are required to obtain an ACDP or Title V operating permitting must register the source with the Oregon DEQ. (LRAPA, 2011d)

¹³³ Air Containment is “a dust, fume, gas, mist, odor, smoke, vapor, pollen, soot, carbon, acid, particulate matter, regulated pollutant, or any combination thereof” (LRAPA, 2011b).

General Conformity

The LRAPA follows the federal General Conformity regulations and do not maintain their own. See Section 7.1.12.2 for a general discussion of the General Conformity regulations.

State Implementation Plan Requirements

The LRAPA SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. LRAPA's SIP is a conglomeration of separate actions taken for each of the pollutants. All of LRAPA's SIP actions are codified under 40 CFR Part 52 Subpart MM (under Oregon). A list of all SIP actions for all six criteria pollutants can be found on USEPA's website.¹³⁴

7.1.12.4. *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 7.1.12-1 and Table 7.1.12-4, below, present the current nonattainment areas in Oregon as of January 30, 2015. Table 7.1.12-4 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 when USEPA promulgated the standard for that pollutant. Note certain pollutants have more than one standard in effect (e.g., note that, for CO, PM₁₀, PM_{2.5}, SO₂). Unlike Table 7.1.12-4, Figure 7.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM₁₀, and PM_{2.5} merge in the figure to count as a single pollutant.

¹³⁴ Oregon's SIP for air quality, state and local requirements are available at:
<https://yosemite.epa.gov/R10/AIRPAGE.NSF/7594bda73086704a88256d7f00743067/0b108e94004620e888257c3600696da7>.

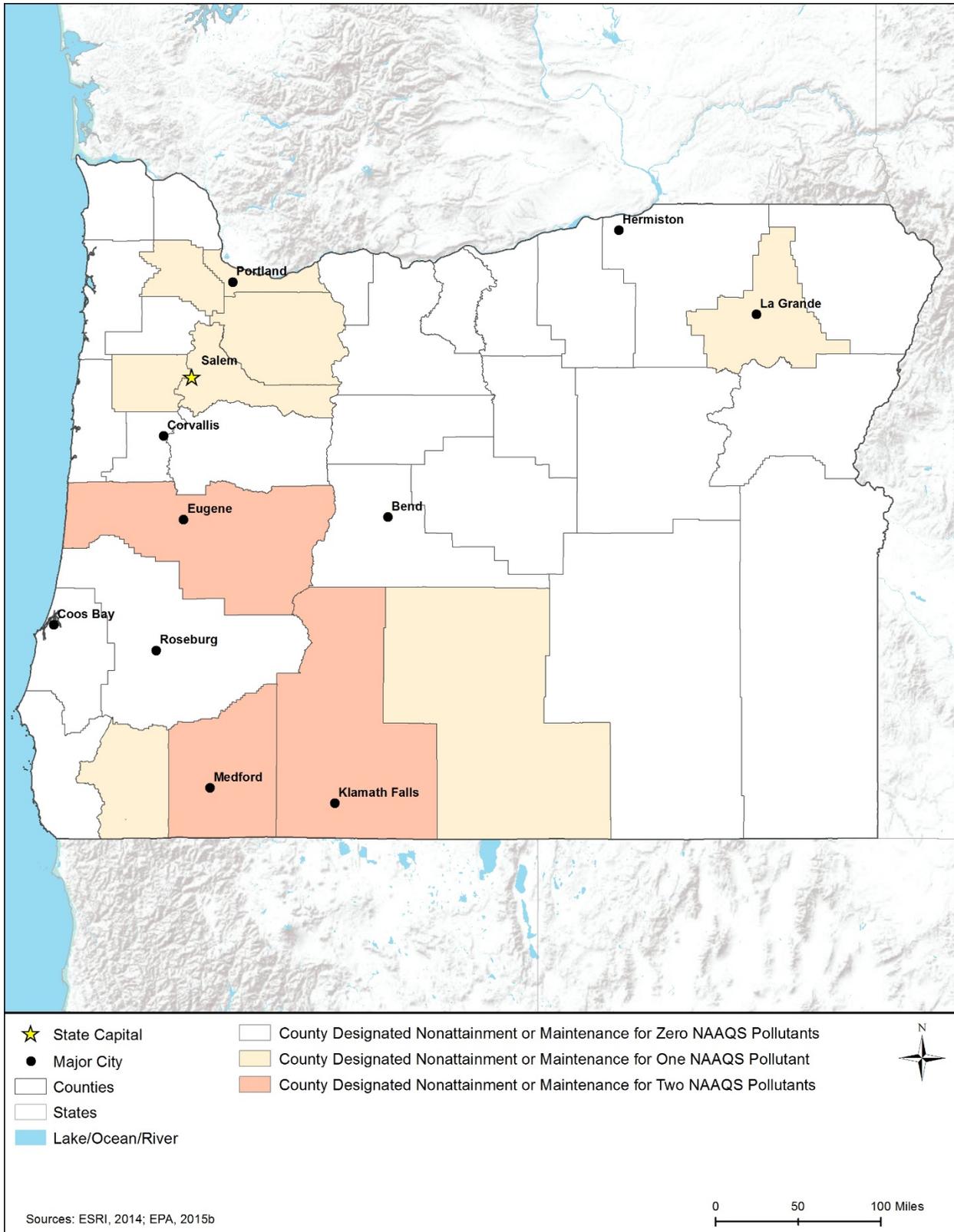


Figure 7.1.12-1: Nonattainment and Maintenance Counties in Oregon

Table 7.1.12-4: Oregon Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant and Year USEPA Implanted Standard										
	CO	Lead		NO ₂	PM ₁₀	PM _{2.5}		O ₃		SO ₂	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Clackamas	M										
Jackson	M				M						
Josephine	M				M						
Klamath	M				M		X-4				
Lake					M						
Lane (Eugene-Springfield, OR)	M				M						
Lane (Lane Co, OR)					X-4						
Lane (Oakridge, OR)							X-4				
Marion	M										
Multnomah	M										
Polk	M										
Union					M						
Washington	M										

Source: (USEPA, 2015h)

- X-1 = Nonattainment Area (Extreme)
- X-2 = Nonattainment Area (Severe)
- X-3 = Nonattainment Area (Serious)
- X-4 = Nonattainment Area (Moderate)
- X-5 = Nonattainment Area (Marginal)
- X-6 = Nonattainment Area (Unclassified)
- M = Maintenance Area

Air Quality Monitoring and Reporting

Oregon DEQ operates the ambient monitoring network for the entire state with the exception of Lane County, which is operated by the LRAPA. LRAPA electronically submits data directly to USEPA and the Oregon DEQ reports data in their annual reports.

The Oregon DEQ and LRAPA measure air pollutants at 54 sites across the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network. Annual Oregon State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region, includes LRAPA data. Oregon DEQ reports real-time pollution levels of O₃, NO_x, PM_{2.5}, and PM₁₀, on their website (<http://www.deq.state.or.us/lab/aqm/rt/rthourlyconc.aspx>) and LRAPA reports real-time pollution levels of PM_{2.5} and O₃, on their website (<http://www.lrapa.org/216/Todays-Current-Air-Quality>).

Throughout 2014, PM_{2.5} exceeded the health standard in Baker City, Bend, Burns, Cove, Enterprise, Hillsboro, John Day, Klamath Falls, La Grande, Lakeview, Medford, Oakridge, Prineville, and Sisters. Also in 2014, O₃ exceeded the federal standard of 0.075ppm twice, in Portland and Salem, however the 3 year average of the fourth highest did not exceed the federal

standard of 0.075ppm. No other criteria pollutants exceed federal standards. (Oregon DEQ - Air Quality Planning, 2015) (LRAPA, 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. § 7472).

In a 1979 USEPA memorandum, the Assistant Administrator for Air, Noise, and Radiation (USEPA, 1979) advised USEPA Regional Offices to provide notice to the Federal Land Manager (FLM) of any facility subject to the Prevention of Significant Deterioration (PSD) permit requirements and within 100 kilometers¹³⁵ of a Class I area. “The EPA’s policy is that FLMs should be notified by the Regional Office about any project that is within 100 kilometers of a Class I area. For sources having the capability to affect air quality at greater distances, notification should also be considered for Class I areas beyond 100 kilometers” (Page, 2012). The 2005 USEPA guidelines for air quality modeling do not provide a precise modeling range for Class I areas.

PSD applies to new major sources or major modifications at existing sources for pollutants where the source is in an attainment or unclassifiable area. An air quality analysis is required for sources subject to PSD requirements and generally consists of using a dispersion model to evaluate emission impacts to the area. “Historically, the EPA guidance for modeling air quality impacts under the PSD program has tended to focus more on the requirements for a Class II modeling analysis. Such guidance has provided that applicants need not model beyond the point of significant impact or the source or 100 kilometers (the normal useful range of EPA-approved Gaussian plume models” (USEPA, 1992a).

Oregon contains 12 Federal Class I areas; the remaining land within the state is classified as Class II (USEPA, 2012a). If an action is considered major source and consequently subject to PSD requirements, the air quality impact analysis need only to analyze the impacts to air quality within 100 kilometers from the source (USEPA, 1992b). California contains five Class I areas and Washington and Idaho contain one Class I area where the 100-kilometer buffer intersects a few Oregon counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. Figure 7.1.12-2 provides a map of Oregon highlighting all relevant Class I areas and all areas within the 100-kilometer radius. The numbers next to each of the highlighted Class I areas in Figure 7.1.12-2 correspond to the numbers and Class I areas listed in Table 7.1.12-5.

¹³⁵ The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.

Table 7.1.12-5: Relevant Federal Class I Areas

# ^a	Area	Acreage	State
1	Mount Hood Wilderness	14,160	OR
2	Mount Jefferson Wilderness	100,208	OR
3	Mount Washington Wilderness	46,116	OR
4	Three Sisters Wilderness	199,902	OR
5	Diamond Peak Wilderness	36,637	OR
6	Strawberry Mountain Wilderness	33,003	OR
7	Kalmiopsis Wilderness	76,900	OR
8	Mountain Lakes Wilderness	23,071	OR
9	Gearhart Mountain Wilderness	18,709	OR
10	Crater Lake NP	160,290	OR
11	Eagle Cap Wilderness	293,476	OR
12	Hells Canyon Wilderness	192,700	ID-OR
13	Mount Adams Wilderness	32,356	WA
14	Redwood NP	27,792	CA
15	Lava Beds/Black Lava Flow Wilderness	28,640	CA
16	Lava Beds/Schonchin Wilderness	28,640	CA
17	South Warner Wilderness	68,507	CA
18	Marble Mountain Wilderness	213,743	CA

Source: (USEPA, 2012a)

^a The numbers correspond to the shaded regions in Figure 7.1.12-2.

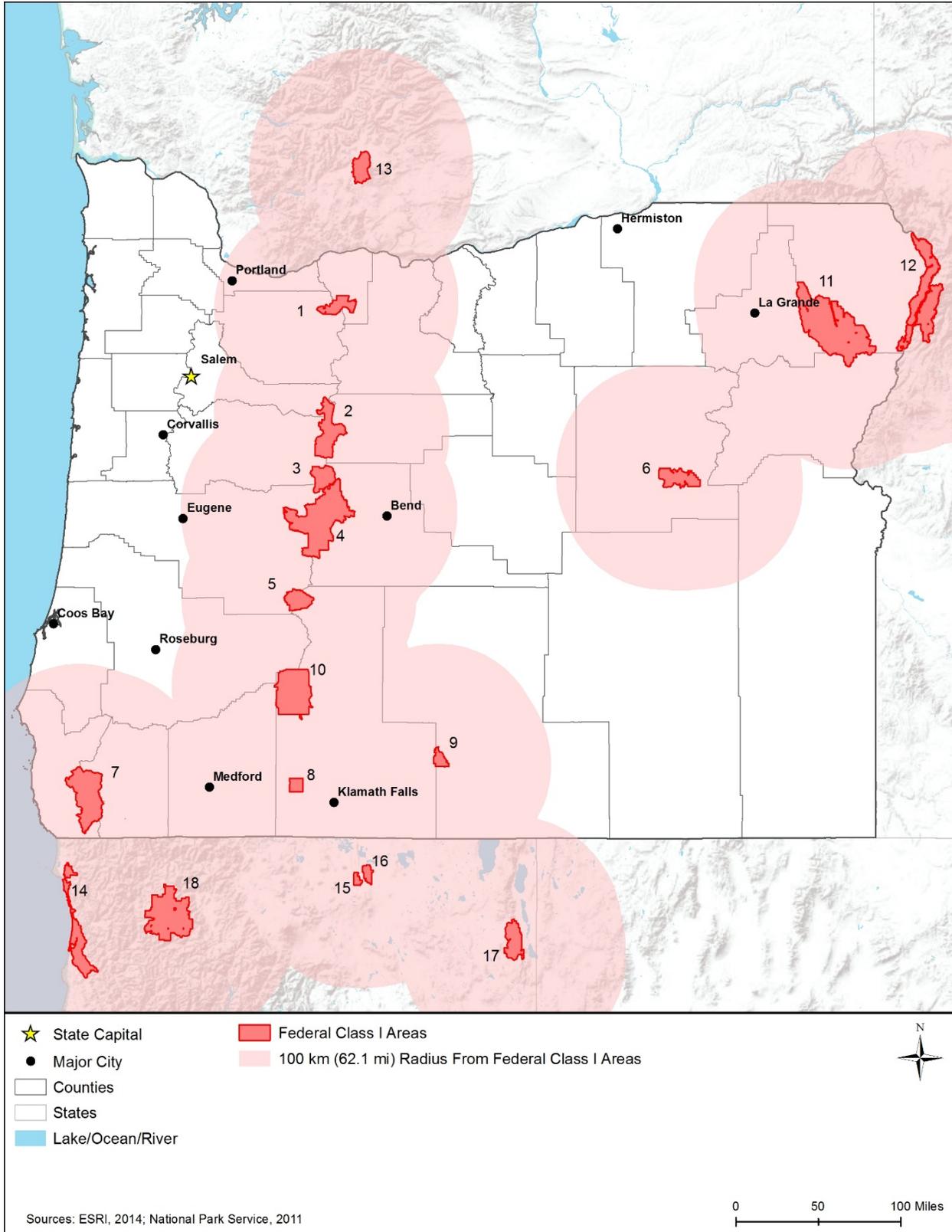


Figure 7.1.12-2: Federal Class I Areas with Implications for Oregon

7.1.13.Noise

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

7.1.13.1. Definition of the Resource

Noise is caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012b). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

7.1.13.2. Fundamentals of Noise

For environmental noise analyses, a noise metric refers to the unit that quantitatively measures the effect of noise on the environment. The unit used to describe the intensity of sound is the decibel (dB). Audible sounds range from 0 dB (“threshold of hearing”) to about 140 dB (“threshold of pain”). The vibration frequency characteristics of the sound, measured as sound wave cycles per second [Hertz (Hz)], determines the pitch of the sound (FTA, 2006). The normal audible frequency range is approximately 20 Hz to 20 kHz (FAA, 2015i). 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, 2013).

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 7.1.13-1 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 7.1.13-1: 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 causes an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably depending on whether the environment is urban, suburban, or rural.

7.1.13.3. 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.

ODEQ has developed statewide noise guidelines. Oregon Administrative Rules Chapter 340, Division 35 addresses a wide variety of noise regulations for the state of Oregon that would apply to various aspects of the Proposed Actions. Aircraft operations, construction activities, and emergency vehicle noise standards are all covered by this regulation (Oregon DEQ, 2015n). Activities conducted under the Proposed Action within the state of Oregon should ensure that they comply with all of the various restrictions and guidelines set forth in this regulation. For instance, this regulation imposes maximum noise levels on motor vehicles in operation based on the year they were manufactured, as well as setting industrial and commercial noise source standards that would apply to generators being operated under the Proposed Action.

Many cities and towns may have additional, local noise ordinances to further manage community noise levels. The noise limits specified in such ordinances are typically applied to define noise sources and specify a maximum permissible noise level. Large cities and towns, such as Portland, Salem, Eugene, and Medford 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). Table 7.1.13-1 provides an overview of Oregon’s state laws relating to noise.

Table 7.1.13-1: Relevant Oregon Noise Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Chapter 340 Division 35	Oregon Department of Environmental Quality (ODEQ)	Defines statewide regulations concerning noise. Covers a wide variety of activities and equipment, from cars and trucks to industrial noise sources. Also, address maximum noise levels from aircraft.

Source: (Oregon DEQ, 2015n)

7.1.13.4. Environmental Setting: Ambient Noise

The range and level of ambient noise in Oregon varies widely based on the area and environment of the area. The population of Oregon can choose to live and interact in areas that are large cities, rural communities, and national and state parks. Figure 7.1.13-1 illustrates noise values for typical community settings and events that are representative of what the population of Oregon may experience on a day-to-day basis. These noise levels represent a wide range and are not specific to Oregon. As such, this section describes the areas where the population of Oregon can potentially be exposed to higher than average noise levels.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The areas that are likely to have the highest ambient noise levels in the state are: Portland (and its neighboring boroughs and cities), Salem, Eugene, and Medford.
- **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 Oregon, Portland International Airport (PDX) has more than 216,000 annual operations¹³⁶ (Portland International Airport, 2015b). These operations result in increased ambient noise levels in the surrounding communities. See Section 7.1.7.9, Oregon Airspace, and Figure 7.1.7-6 for more information about airports in the state.
- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (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 7.1.1, Public Safety Infrastructure, and Figure 7.1.1-1 for more information about the major highways in the state.

¹³⁶ For PDX Fiscal Year ending in June 2015.

- **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 (DOT, 2015). Oregon has multiple rail corridors with high levels of commercial and commuter rail traffic. These major rail corridors extend mainly from Portland out along the four cardinal directions depending on the rail line. For instance, the Union Pacific rail line goes south and east from Portland, the BNSF rail line goes east and north, and a series of smaller rail lines go to the south and west of Portland. There are also a number of other rail corridors that join these major rail lines and connect with other cities (ODOT, 2015g). See Section 7.1.1, Public Safety Infrastructure, and Figure 7.1.1-1 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, which are regions that are given legal safeguards in order to maintain biological diversity and natural resources (NPS, 2013a). These areas typically have lower noise levels, as low as 30 to 40 dBA (NPS, 2014g). Oregon has one National Park, two National Monuments, two National Historic Parks, and one National Historic Site, and 10 National Natural Landmarks (NPS, 2015a) (NPS, 2012b). Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 7.1.8, Visual Resources, and for more information about national and state parks for Oregon.

7.1.13.5. 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, 2014b). Most cities and towns in Oregon 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 Oregon.

7.1.14. Climate Change

7.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "...a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the

main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO₂-equivalent¹³⁷ (MT CO₂e), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO₂ only, the units are in million metric tons (MMT) CO₂. Where the document references emissions of multiple GHGs, the units are in MMT CO₂e.

The IPCC reports that “global concentrations of these four GHGs have increased significantly since 1750” with “atmospheric concentrations of CO₂ increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005” (IPCC, 2007). The atmospheric concentration of CH₄ and N₂O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see Chapter 7.2.14, 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; 3) sea level; and 4) severe weather events.

7.1.14.2. 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. Oregon has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 7.1.14-1, two key state laws/regulations are the primary policy drivers on climate change preparedness and GHG emissions.

¹³⁷ CO₂e refers to Carbon Dioxide Equivalent, “A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents (MMT CO₂e). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. MMT CO₂e = (million metric tons of a gas) * (GWP of the gas)” (USEPA, 2015s).

Table 7.1.14-1: Relevant Oregon Climate Change Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
HB 3543	State of Oregon	The Oregon Global Warming Commission was created by the 2007 Legislature through House Bill 3543. In March 2008, the Governor appointed the 11 voting members of the Commission. The Commission’s general charge was to recommend ways to coordinate state and local efforts to reduce Oregon’s GHG emissions consistent with Oregon’s goals and to recommend efforts to help the state, local governments, businesses, and residents prepare for the effects of global warming (Keep Oregon Cool, 2009). The Commission determined Oregon’s long term goal is to reduce the state’s global warming pollution to 75 percent below 1990 levels by 2040 (Oregon.gov, 2015e).
OAR 660-044	State of Oregon	In 2011, the Oregon Land Conservation and Development Commission adopted rules (OAR 660-044) setting targets to guide long range planning by Oregon’s largest urban areas to reduce GHG pollution from auto travel. The rules call for local planners to explore ways to reduce pollution from auto and light truck travel by 17 percent to 21 percent per person by the year 2035 (in addition to reductions from technology and state and federal actions) (Oregon.gov, 2015e).

7.1.14.3. Oregon Greenhouse Gas Emissions

Estimates of Oregon’s total GHG emissions vary. The Department of Energy’s (DOE) Energy Information Agency (EIA) collects and disseminates national-level emissions data on other GHGs such as CH₄ and nitrous oxide (NO_x), but not at the state level (EIA, 2011). The USEPA also collects and disseminates national-level GHG emissions data, but by economic sector, not by state (USEPA, 2015i). Individual states have developed their own GHG inventories, which are updated with different frequencies and trace GHG in a variety of ways.

For the purposes of this PEIS, the EIA data on CO₂ emissions is used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH₄, they are described and cited.

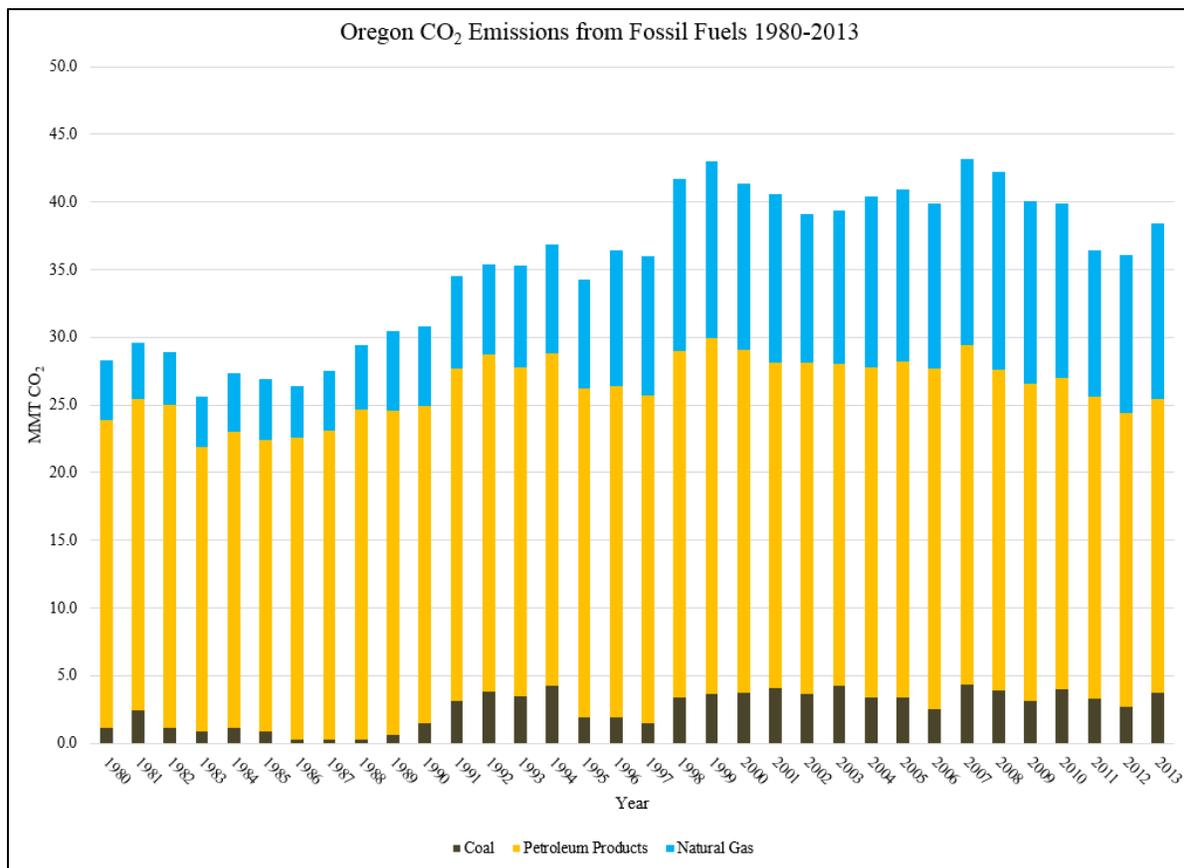
According to the EIA, Oregon emitted 38.4 MMT of CO₂ in 2013 (Table 7.1.14-2) (EIA, 2015d). Slightly more than half of total CO₂ emissions are from petroleum products used in the transportation sector. Natural gas is the next-largest source of emissions at 34 percent, which is distributed across all sectors (transportation is only a minor source) (Figure 7.1.14-1) (EIA, 2015e). Oregon’s overall CO₂ emissions are relatively low because 73 percent of its net electricity generation comes hydropower and other renewable resources (EIA, 2015f). Annual emissions grew intermittently by more than 50 percent between 1980 and 1999. Between 1980 and 2013, emissions declined, then increased to their 2007 maximum of 43.1 MMT, and then fell to 36.1 MMT in 2012 (EIA, 2015e). In 2013, emissions increased by 2.3 MMT, mostly from increases in emissions from the electric power sector. Overall variations in CO₂ emissions result from fluctuations in the use of coal (EIA, 2015e). Increases have been caused largely by the use of petroleum products and natural gas, especially in the electric power sector (EIA, 2015e). In

2013, Oregon was ranked 39th in the U.S. for total CO₂ emissions (EIA, 2015f), and 44th for per-capita CO₂ emissions (EIA, 2015f).

Table 7.1.14-2: Oregon CO₂ Emissions from Fossil Fuels by Fuel Type and Sector, 2013

Fuel Type (MMT)		Source (MMT)	
Coal	3.7	Residential	2.8
Petroleum Products	21.8	Commercial	1.8
Natural Gas	13.0	Industrial	4.7
		Transportation	20.0
		Electric Power	9.0
TOTAL	38.4	TOTAL	38.4

Source: (EIA, 2015e)



Source: (EIA, 2015e)

Figure 7.1.14-1: Oregon CO₂ Emissions from Fossil Fuels by Fuel Type 1980-2013

The majority of Oregon's GHG emissions are CO₂. 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 Oregon are CH₄, hydrofluorocarbons, NO_x, sulfur hexafluoride (SF₆) and perfluorocarbons (ODOE, 2013).

The Oregon Department of Energy, Environmental Quality, and Transportation in 2013 published 2010 GHG emissions inventory for the state (ODOE, 2013). Total U.S. GHG emissions were 5,278.6 million metric tons (14.7 trillion pounds) in 2013 (EIA, 2015g). In 2013, Oregon emitted 38.4 million metric tons of CO₂ (EIA, 2015g). Oregon has lower per-capita energy-related GHG emissions than the U.S. average. Emissions came from energy related activities across all sectors such residential (7.3 percent) commercial (4.7 percent) industrial (12.2 percent) and transportation (52.1 percent). At 52.1 percent, the transportation sector contributes the majority of GHG emissions in Oregon in 2013 (EIA, 2015e).

Oregon is not a producer of crude oil nor is there coal mining in the state; resources enter by pipeline and rail and are not a large component of energy or industrial sector emissions, which keeps oil- and coal-associated emissions low. Oregon has more than 50 natural gas reservoirs but still receives a portion of this resource through interstate pipelines. Overall, GHG emissions from electricity generation are low because hydroelectricity supplies more than one-half, while the remaining electricity needs are supplied by a combination of natural gas, wind generation, and coal. (ODOE, 2013) (EIA, 2015h)

GHG emissions from agriculture, industry, residential, and commercial processes increased between 1990 and 1999, but have declined since 2007. Between 1990 and 2010, transportation emissions grew 30 percent. "Transportation has remained the largest contributor to the state's in-boundary emissions (22.6 million metric tons CO₂), however emissions from the residential and commercial sectors have grown to similar levels in recent years (22.3 million MT CO₂e in 2010)." (ODOE, 2013) Air passenger travel and freight markets contributed the most to Oregon's growth between 1990 and 2010. During the same time, the number of passenger vehicles decreased along with vehicle-related emissions. This is likely a result of new emission regulations and vehicle energy standards. Overall, emissions across all sectors have declined since 2007 and Oregon's has met its 2010 emission reduction goal (ODOE, 2013), (EIA, 2015h).

7.1.14.4. 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, 2011b).

Across the United States, the five most common climate groups are (A), (B), (C), (D), and (E). The majority of Oregon falls into climate group C (Figure 7.1.14-2). Climates classified as (C) are warm, with humid summers and mild winters. During winter months, “the main weather feature is the mid-latitude cyclone” (NWS, 2011a). During summer months, thunderstorms are frequent. Although a majority of the state falls into climate group C, a small portion of east central Oregon fall into climate group D. Climates classified as (D) are “moist continental mid-latitude climates,” with “warm to cool summers and cold winters” (NWS, 2011a). In (D) climates, the “average temperature of the warmest month is greater than 50 degrees Fahrenheit (°F), while the coldest month is less than negative 22 °F” (NWS, 2011a). Winter months in (D) climate zones are cold and severe with “snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses” (NWS, 2011a) (NWS, 2011b). Lastly, areas of central, southeastern, and southern Oregon fall into climate group B. Climates classified as (B) are dry climates, “in large continental regions of the mid-latitudes often surrounded by mountains” (NWS, 2011a). “The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation” (NWS, 2011a). Oregon has four sub-climate categories, which are described in the paragraphs below. (NWS, 2011a) (NWS, 2011b)

Bsk – The Köppen-Geiger climate classification system classifies central, southern, and southeastern regions 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)

Cfa – The Köppen-Geiger climate classification system classifies a small region of northeastern Oregon, as Cfa. Cfa climates are generally warm, with humid summers and mild winters. In this climate classification zone, the secondary classification indicates year-round rainfall, but it is highly variable; thunderstorms are dominant during summer months. In this climate classification zone, the tertiary classification indicates mild, hot summers with average temperature of warm months over 72 °F. Average temperatures of the coldest months are under 64 °F. (NWS, 2011a) (NWS, 2011b)

Csb – The Köppen-Geiger climate classification system classifies the majority of Oregon as Csb. Csb climates are Mediterranean, 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)

Dsb – The Köppen-Geiger climate classification system classifies a small region of northeastern central Oregon as Dsb. Climates classified as Dsb experience dry conditions, with warm summers, and ample snow. Dsb climates experience at least one month that is colder than 26 °F. This climate is generally found in high elevations. (GLOBE SCRC, 2015) (NWS, 2011a) (NWS, 2011b)

to 71 °F. Extreme temperature variations in Oregon are rare; “only occasionally do winter storms bring freezing temperatures and high winds, while fog up to about the 500 foot elevations moderates the summer temperatures” (Oregon Coastal Management Program, 2015). (Dello, 2015)

In eastern Oregon, maximum temperatures are slightly higher and minimum temperatures are slightly lower, “largely due to the lack of cloud cover” (Dello, 2015). The highest temperature to occur in Oregon was on July 29, 1898 and August 10, 1898 with a record high of 119 °F (SCEC, 2015). The lowest temperature to occur in Oregon was on February 9, 1933 and February 10, 1933 with a record low of negative 54 °F (SCEC, 2015).

The following paragraphs describe annual temperatures as they occur in the various climate classification zones:

Bsk – Burns, located in southeastern Oregon, is within the climate classification zone Bsk. The average annual temperature in Burn is approximately 44.5 °F; 25.8 °F during winter months; 63.3 °F during summer months; 43.9 °F during spring months; and 44.6 °F during autumn months. (NOAA, 2015i)

Cfa – Enterprise, located in northeastern Oregon, is within the climate classification zone Cfa. The average annual temperature in Enterprise is approximately 45.1 °F; 28.0 °F during winter months; 62.3 °F during summer months; 44.5 °F during spring months; and 45.2 °F during autumn months (NOAA, 2015i).

Csb – The majority of Oregon, including Portland, is located within the climate classification zone Csb. The average annual temperature in Portland is approximately 54.5 °F; 41.8 °F during winter months; 67.5 °F during summer months; 52.9 °F during spring months; and 55.3 °F during autumn months (NOAA, 2015i).

Dsb – Bend, located in north central Oregon, is within the climate classification zone Dsb. The average annual temperature in Bend is approximately 47.0 °F; 32.8 °F during winter months; 62.2 °F during summer months; 44.9 °F during spring months; and 47.9 °F during autumn months (NOAA, 2015i).

Precipitation

Precipitation throughout the state varies substantially in accordance with proximity to the coast. “Areas along the Coast Range can receive upwards of 200” of precipitation annually, while the southeastern plateau sees less than 10” per year” (Dello, 2015). Statewide, Oregon receives an average of 27.38 inches of precipitation annually. In western Oregon, the Willamette Valley is home to approximately 70 percent of the state’s population. The Valley is also home to the state’s largest city, Portland. This western region receives approximately 40 to 50 inches of precipitation annually (Dello, 2015). The majority of precipitation within this region falls between October and March. Seasonal precipitation is similar throughout eastern regions, “but amounts are typically smaller and snow is a bit more common” (Dello, 2015). The greatest 24-

hour precipitation accumulation occurred on November 6, 2006 with a total of 11.77 inches. (SCEC, 2015).

Snowfall is largely confined to higher elevations (4,500 feet or higher), “and is crucial for summer water supply in the state” (Dello, 2015). Snowfall does occur at lower elevations; however, accumulation amounts are much lower than in higher elevations. The state’s highest snowfall total occurred at Hood River in January of 1980 with a total of 47 inches. The largest recorded snow depth was recorded in April of 1983 in Crater Lake National Park with a total of 252 inches. The greatest 24-hour snowfall accumulation occurred on January 9, 1980 with a total of 47 inches (SCEC, 2015).

The following paragraphs describe annual precipitation as it occurs in the various climate classification zones:

Bsk – Burns, located in southeastern Oregon, is within the climate classification zone Bsk. The average annual precipitation accumulation in Burns is approximately 10.92 inches; 3.76 inches during winter months; 1.52 inches during summer months; 3.25 inches during spring months; and 2.39 inches during autumn months (NOAA, 2015i).

Cfa – Enterprise, located in northeastern Oregon, is within the climate classification zone Cfa. The average annual precipitation accumulation in Enterprise is approximately 19.03 inches; 4.78 inches during winter months; 4.24 inches during summer months; 5.88 inches during spring months; and 4.13 inches during autumn months (NOAA, 2015i).

Csb – The majority of Oregon, including Portland, is located within the climate classification zone Csb. The average annual precipitation accumulation in Portland is approximately 36.03 inches; 14.03 inches during winter months; 3.02 inches during summer months; 8.88 inches during spring months; and 10.10 inches during autumn months (NOAA, 2015i).

Dsb – Bend, located in north central Oregon, is within the climate classification zone Dsb. The average annual precipitation accumulation in Bend is approximately 9.96 inches; 2.96 inches during winter months; 2.08 inches during summer months; 2.56 inches during spring months; and 2.36 inches during autumn months (NOAA, 2015i).

Sea Level

“Oregon’s coastal zone encompasses about 7,800 square miles of land area” (Oregon Coastal Management Program, 2015). Compared to other areas of the county, Oregon’s coastal zone is sparsely populated, home to approximately 225,000 people; approximately 6.5 percent of the state’s overall population. Nevertheless, much of Oregon’s shoreline is at risk for damage from strong winds, heavy rainfall, flooding, and El Nino and La Nina weather patterns. Since 1900, approximately eight inches of “warming-driven global sea level rise” has occurred (Climate Central, 2014). Unlike along the east coast of the U.S., sea level rise along the west coast is largely influenced by climate patterns such as El Niño-Southern Oscillation and Pacific Decadal Oscillation. These climate patterns affect winds and ocean circulation, “raising sea level during warm phases (e.g., El Niño) and lowering sea level during cool phases (e.g., La Niña). During

large El Niño events, sea level along the coast can rise by as much as 10 to 30 centimeters. In addition, Oregon is largely susceptible to land subsidence. Land in Oregon is subsiding by approximately 1 to 2 millimeters per year. (The National Academies Press, 2012)

Severe Weather Events

Statewide, severe weather is relatively uncommon to Oregon. For example, between 1950 and 1995, 50 tornadoes were recorded, the majority rated as F0 tornadoes (light damage) to F1 (moderate damage).¹³⁸ To date, Oregon has not experienced and injuries or deaths related to tornado outbreaks. Washington County has experienced the most tornado outbreaks in comparison to other counties, with five tornadoes between 1954 and 1993. (State of Oregon, 2010)

Windstorms in Oregon are most common along the coast, Cascades Ranges, and other exposed coastal plains. In many cases, wind gusts can exceed 100 miles per hour (mph) and occur several times each year. In highly exposed coastal range areas, wind gusts can reach up to 150 mph, with sustained speeds of 110 mph or greater occurring every 5 to 10 years. The state's most destructive and deadly windstorm occurred on October 12, 1962 in Willamette Valley. Monetary losses reached approximately \$200 million, with 38 deaths and even more injuries (State of Oregon, 2010). Another severe windstorm occurred on October 2, 1967, with the strongest winds to have occurred in the state since the Columbus Day storm in 1962. Affected areas include much of western, central, and northeastern Oregon. During the storm, wind speeds reached 100 to 115 mph. As a result, one person was killed and over 15 were injured. (State of Oregon, 2010)

Hailstorms are also uncommon to Oregon, with storms occurring approximately two to three times per year. In addition to infrequency, hailstorms are generally mild, with a few occurrences of severe hail. During one severe storm in 1995, crop and property damage each amounted to approximately \$30 million. Another significant hailstorm occurred on September 4, 1997 when hail the size of marbles "destroyed 20 percent of the Rogue Valley's pear crop" (State of Oregon, 2010). In total, this storm caused approximately \$10 million in damages. Avalanches in Oregon are typically localized and do not affect large areas or large numbers of people. At present, Oregon has experienced eight fatalities due to avalanches. (State of Oregon, 2010)

Flooding is Oregon's most destructive severe weather event, with many areas considered high-risk flood zones. One of Oregon's deadliest floods occurred in 1903 in Heppner. During this flood, heavy localized thunderstorms and hail caused severe flash flooding along Willow Creek. In a few short minutes, the entire town was washed away, killing approximately 247 people. (NWS, 2015a)

More recently, flooding in February of 1996 along the entire Pacific Northwest caused over \$1 billion in damages. This flooding event was the result of heavy, above-average precipitation and snowfall, excessive snowmelt, and a subtropical jet, which brought warm, moist air into the

¹³⁸ "Fujita Scale (or F Scale) of tornado damage intensity. The F Scale was developed based on damage intensity and not wind speed; wind speed ranges given are estimated, based on the extent of observed damage." (NOAA 2016d)

region resulting in very heavy rain and rapid snowmelt. In total, eight people were killed and several more were injured. (NWS, 2015a)

7.1.15. Human Health and Safety

7.1.15.1. 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 because 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 or vehicle traffic. Vehicle traffic and the transportation of hazardous materials and wastes are evaluated in Section 7.1.1, Infrastructure.

7.1.15.2. Specific Regulatory Considerations

Federal organizations, such as OSHA, USEPA, the U.S. Department of Health and Human Services (DHHS), and others protect human health and the environment. In Oregon, the Oregon Bureau of Labor and Industries (OBOLI), and the ODEQ regulate this resource area. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Oregon’s Occupational Safety and Health Administration (OR-OSHA) is an OSHA-approved “State Plan,” which has unique state and local government employment regulations for forest activity, agriculture, and firefighter and pesticide worker protection (OSHA, 2015a). OSHA enforces occupational safety and health regulations at the state level by Oregon OSHA compliance officers and at the federal level. The Oregon Health Authority, Public Health Division (OHA-PHD), regulates public health.

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 7.1.15-1 below summarizes the major Oregon laws relevant to the state’s occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 7.1.15-1: Relevant Oregon Human Health and Safety Laws and Regulations

State Law and Regulation	Regulatory Agency	Applicability
Oregon Administrative Rules: Chapter 340, Division 40	Oregon Department of Environmental Quality (ODEQ)	Establishes minimum groundwater quality protection requirements for federal and state agencies, as well as local governments.

State Law and Regulation	Regulatory Agency	Applicability
Oregon Administrative Rules: Chapter 340, Division 43	ODEQ	Regulations to prevent water pollution by requiring the control of chemicals used in mining operations to extract metals from the ore, which produce hazardous wastes or wastewaters.
Oregon Administrative Rules: Chapter 437	Oregon Occupational Safety and Health Administration (OR-OSHA)	Adopts 29 CFR 1910 and describes state-specific Occupational Safety and Health standards pertaining to forest activity, agriculture, and firefighter and pesticide worker protection.
Oregon Administrative Rules: Chapter 333	Oregon Health Authority, Public Health Division (OHA-PHD)	Describes procedures for the preservation of public health during emergencies.
Oregon Administrative Rules: Chapter 632; Divisions 30, 33, 35, 37, and 38	Oregon Department of Geology and Mineral Industry (ODOGAMI)	Provides protection and reclamation for lands and water resources affected by surface and underground mining.

7.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites. Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks may also be performed at dangerous heights or in confined spaces, while operating heavy equipment, on energized equipment near underground and overhead utilities, and while using hazardous materials, such as flammable gases and liquids. Because telecommunication workers are often required to perform work outside, heat and cold exposure, precipitation, and lightning strikes also present hazard and risks depending on the task, occupational competency, and work-site monitoring (OSHA, 2016a). A summary description of the health and safety hazards present in the telecommunication occupational work environment is listed below.

Working from height, overhead work, and slips, trips, or falls – At tower and building-mount sites, workers regularly climb structures using fixed ladders or step bolts to heights up to 2,000 feet above the ground’s surface (OSHA, 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 public who may be observing the work or transiting the area (International Finance Corporation, 2007).

Trenches and confined spaces – Installation of underground utilities, building foundations, and work in utility manholes¹³⁹ are examples of when confined space work is necessary. Installation of telecommunication activities involves laying conduit in small trenches (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker

¹³⁹ Manholes may be used for telecommunications activities, especially in cities and urban areas, depending on the location of other utilities. In cities, power, water, and telecommunication lines are often co-located; if access is through a manhole in the street, that access will be used.

movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. (OSHA, 2016c)

Heavy equipment and machinery – New and replacement facility deployment and maintenance can involve the use of heavy equipment and machinery. During the lifecycle of a telecommunication site, heavy equipment such as bulldozers, backhoes, dump trucks, cement trucks, and cranes are used to prepare the ground, transport materials, and soil, and raise large sections of towers and antennas. Telecommunication workers may be exposed to the additional site traffic and often work near heavy equipment to direct the equipment drivers and to accomplish work objectives. Accessory machinery such as motorized pulley systems, hydraulic metal shears, and air driven tools present additional health and safety risks 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 generated during termination and splicing activities can penetrate exposed skin (International Finance Corporation, 2007). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such as diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (see Section 7.1.13, 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 public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016c)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under wetlands and waterways, including lakes, rivers, ponds, and streams. Workers responsible for these activities operate heavy equipment from soft shorelines, boats, barges, and other unstable surfaces. There is potential for equipment and personnel falls, as well as drowning in waterbodies. Wet work conditions also increase risks of electric shock and hypothermia. (OSHA, 2016c)

Outdoor elements – Weather conditions have the potential to quickly and drastically reduce safety, and increase hazards at telecommunication work sites. Excessive heat and cold conditions impact judgement, motor skills, hydration, and in extreme cases may lead to hyper- or hypothermia. Precipitation, such as rain, ice, and snow, create slippery climbing conditions and wet or muddy ground conditions. Lightning strikes are risks to telecommunication workers climbing towers or working on top of buildings. (OSHA, 2016c)

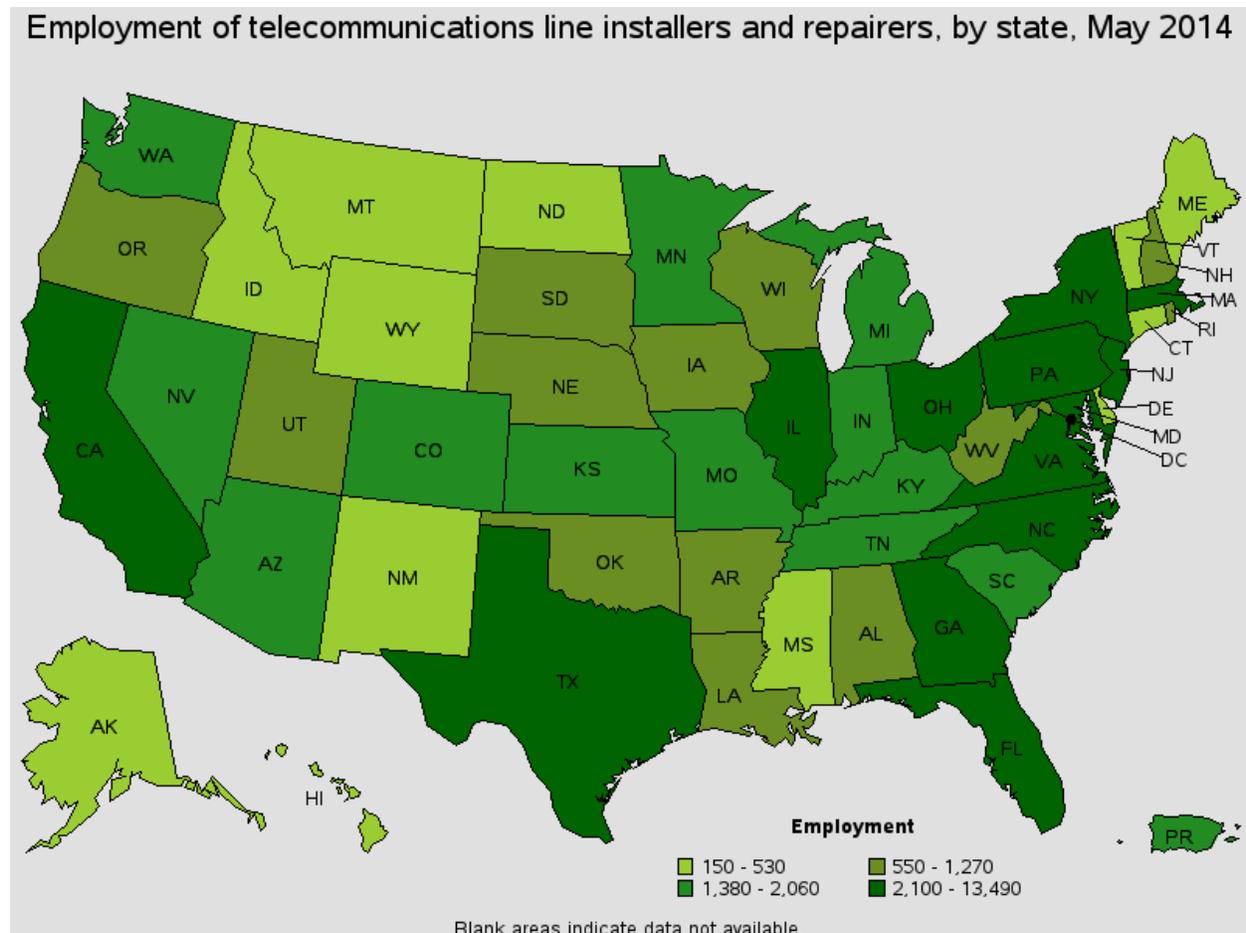
Telecommunication Worker Occupational Health and Safety

The Bureau of Labor Statistics (BLS) uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as both telecommunication equipment installers and repairers, except line installers (SOC code 49-2022), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2015, there were 2,880 telecommunication equipment installers and repairers, and 690 telecommunication line installers and repairers (Figure 7.1.15.1) working in Oregon (BLS, 2015c). In 2013, the most recent year data is available, Oregon had 3.0 cases of nonfatal occupational injuries or illnesses in the telecommunications industry per 100 full-time workers (BLS, 2013a). By comparison, there were 1.9 nonfatal occupational injury cases nationwide in both 2012 and 2013 per 100 full-time workers in the telecommunications industry (BLS, 2013b).

Nationwide in 2013, there were 18 fatalities reported across the telecommunications industry (5 due to violence and other injuries by persons or animals; 3 due to transportation incidents; and 7 due to slips, trips, or falls), with an hours-based fatal injury rate of 7.9 per 100,000 full-time equivalent workers (BLS, 2013c). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Oregon had one occupational fatality in the telecommunications equipment installers and repairers occupation (SOC code 49-2022) in 2012. By comparison, within the broader installation,

maintenance, and repair occupations (SOC code 49-0000), there were 60 fatalities in Oregon between 2003 and 2014, with the highest fatality years being 2009 and 2014, with 8 fatalities each (BLS, 2015d).



Source: (Bureau of Labor Statistics, 2015a)

Figure 7.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Public Health and Safety

The public is unlikely to encounter occupational hazards at telecommunication sites due to limited access. The OHA-PHD collects public and community health indicator data through the Oregon State Health Profile, and helps determine priority areas for the State Health Improvement Plan (Oregon Public Health Division, 2015a). The same data is reported with more specificity at the federal level through the Centers for Disease Control and Prevention Wide-ranging Online Data for Epidemiologic Research (WONDER). While the WONDER database cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 1999 and 2013, there were 112 fatalities due to a fall from, out of, or through a building or structure; 27 fatalities 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, 2015a). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

7.1.15.4. 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 Program¹⁴⁰ 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.

Oregon's Site Response Program is managed under ODEQ, and oversees federal superfund and NPL sites in the state of Oregon (Oregon DEQ, 2015o). As of June 2016, Oregon had 23 RCRA Corrective Action sites,¹⁴¹ 302 brownfield sites, and 15 proposed or final Superfund/NPL sites (USEPA, 2015j). Based on a September 2015 search of USEPA Cleanups in My Community (CIMC) database, there are two Superfund sites in Oregon where contamination has been detected at an unsafe level, or a reasonable human exposure risk still exists (North Ridge Estates near Klamath Falls, OR, and Portland Harbor near Portland, OR) (USEPA, 2015k).

Brownfield sites in Oregon may enroll in a variety of programs managed by the ODEQ (Oregon DEQ, 2015p), such as the OHA-PHD's Brownfields Initiative (Oregon Public Health Division, 2015b), and the Brownfields Cleanup Program implemented by the Oregon Economic and Community Development Department (Oregon Economic & Community Development Department, 2015). ODEQ's Voluntary Cleanup Program provides property owners a streamlined process to clean up hazardous sites, while providing ODEQ oversight and compliance with Oregon regulations (Oregon DEQ, 2015q). One example of a brownfield site is the St. Helens Waterfront Area in St. Helens, OR. The site includes 229 acres of former industrial property along the Columbia River, which was home to the White Paper Mill and the Veneer Plant. The site went unused due to perceived environmental contamination until ODEQ

¹⁴⁰ 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 2011a).

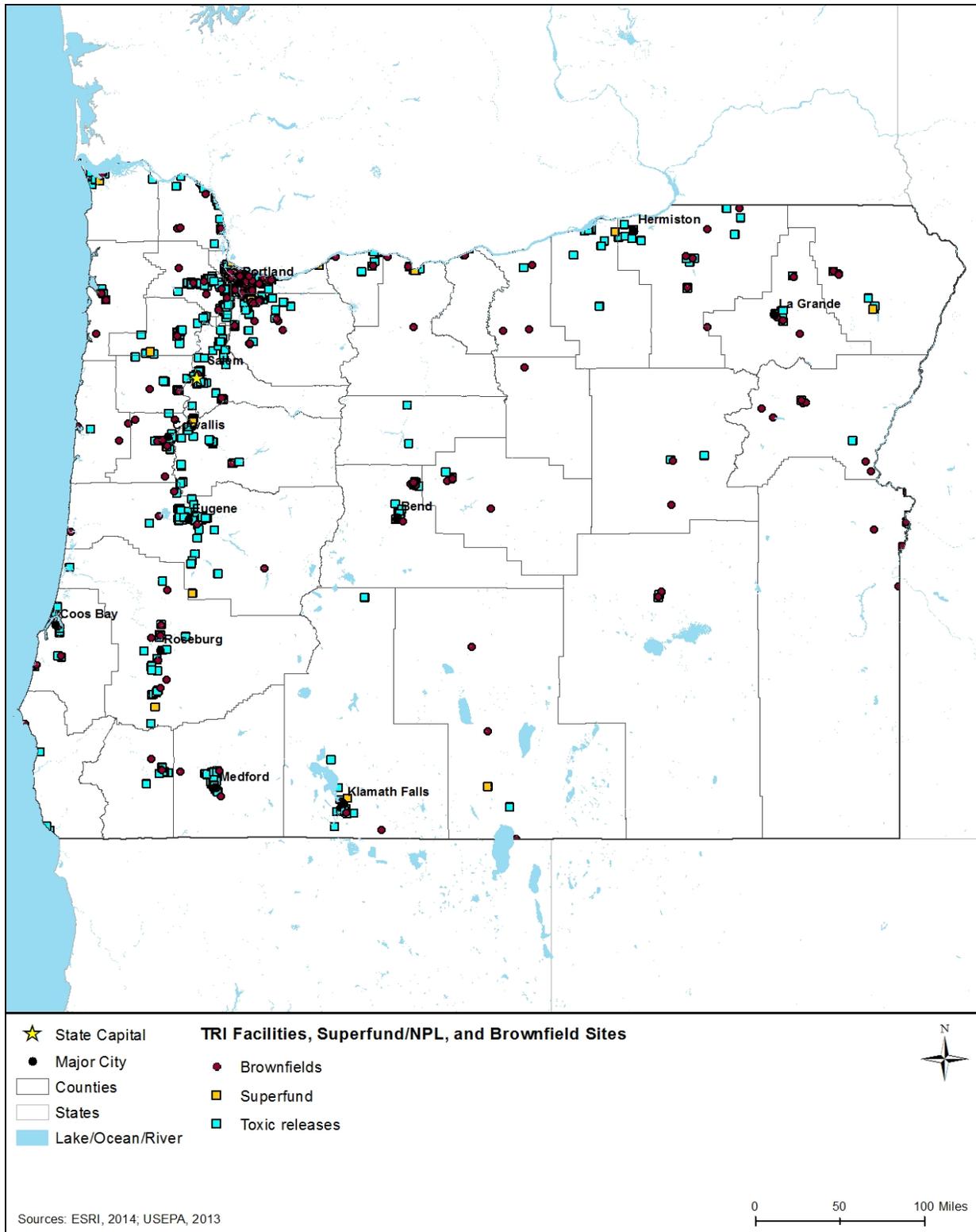
¹⁴¹ Data gathered using USEPA's CIMC search on November 19, 2015, for all sites in Oregon, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013d).

began investigating the site in 1988. ODEQ has since provided oversight and assistance to the site owners to develop investigation and cleanup programs to protect human health. The site received more than \$200,000 in redevelopment funding and tax credits from the USEPA, to redevelop the former mill sites into public riverfront access, providing recreational and economic benefits to the area. (Oregon DEQ, 2015r)

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The Toxic Release Inventory database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The “releases” do not necessarily equate to chemical exposure by humans or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of October 2015, Oregon had 282 TRI reporting facilities (Figure 7.1.15-2). The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Oregon released 17.0 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the hazardous waste/solvent industry and paper industry. This accounted for 0.41 percent of nationwide TRI releases, ranking Oregon 50 of 56 U.S. states, and territories based on total releases per square mile. (USEPA, 2015l)

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of November 12, 2015, Oregon had 69 permitted major discharge facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015m).

The National Institutes of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to “visually explore data from the USEPA’s TRI and Superfund Program” (NIH, 2015a). Figure 7.1.15-2 provides an overview of potentially hazardous sites in Oregon.



Source: (NIH, 2015b)

Figure 7.1.15-2: TOXMAP Superfund/NPL and TRI Facilities in Oregon (2013)

Telecommunication Work 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 10 USEPA-regulated telecommunications sites in Oregon (USEPA, 2015n). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Oregon has not reported any occupational fatalities since 2003 within the installation, maintenance, and repair occupations (SOC code 49-0000) from exposure to "harmful substances or environments" (BLS, 2015e). By comparison, the BLS reported three fatalities in 2011 and three fatalities in 2014¹⁴² nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments (BLS, 2015f). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors.

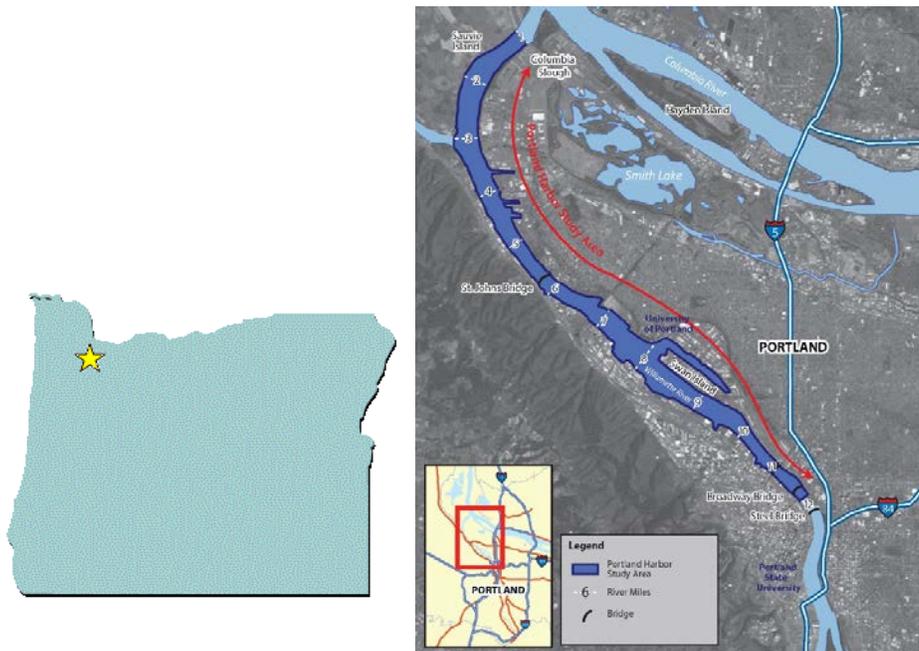
The OHA-PHD collects environmental and public health data through the Oregon Environmental Public Health Tracking (Oregon EPHT) portal (Oregon Public Health Division, 2015c). At the federal level, the Centers for Disease Control and Prevention, National Environmental Public Health Tracking Network, provides health, exposure, and hazard information, including known chemical contaminants, chronic diseases, and conditions based on geography. In 2011, the most recent data available, Oregon reported a rate of one injury and/or fatality due to reported acute toxic substance release incidents per 100,000 population (Centers for Disease Control and Prevention, 2015b).

¹⁴² BLS Census of Fatal Occupational Injuries data for 2014 is for preliminary reporting only. Final data are expected to be released in spring 2016 (Bureau of Labor Statistics, 2015).

Spotlight on Oregon Superfund Sites: Portland Harbor Superfund Site

The Portland Harbor is a heavily industrialized section of the Willamette River in Portland, OR. Water and sediments in the river are contaminated with metals, PCBs, polynuclear aromatic hydrocarbons (PAHs), dioxin, and pesticides. Contaminants have also been found in fish in the Willamette River. The USEPA added the harbor to the NPL in December 2000, and is working with ODEQ to identify responsible parties to clean up contaminated river sediments. (USEPA, 2015q)

In 2006, the Agency for Toxic Substances and Disease Registry (ATSDR) identified the site as constituting a “public health hazard” due to the increased risk of adverse health effects from the consumption of PCB-contaminated fish taken from the Willamette River (Agency for Toxic Substances and Disease Registry, 2006). The ODEQ is in the process of developing a cleanup plan to present a feasibility study (Figure 7.1.15-2) and outline remediation strategies for the site. Two sites along the river (Triangle Park and U.S. Moorings) which represent an immediate threat have completed “Early Action” cleanup activities, and four additional areas have begun cleanup. (USEPA, 2015q)



Source: (USEPA 2015w)

Figure 7.1.15-2: Portland Harbor Study Area in Portland, OR

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

Another health and safety hazard in Oregon includes surface and subterranean mines. In 2015, the Oregon mining industry ranked 36th for non-fuel minerals (primarily crushed stone, construction sand and gravel, portland cement, diatomite, and crude perlite), generating a value of \$398M (USGS, 2016c). Health and safety hazards at active mines and abandoned mine lands (AML) include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (Federal Mining Dialogue, 2015).

The Oregon Department of Geology and Mineral Industries administers the Mineral Land Regulation and Reclamation program, and is responsible for the permitting and reclamation of surface mines in Oregon (Oregon Department of Geology and Mineral Industries, 2015d). According to the BLM, Oregon has approximately 5,827 abandoned hardrock mines (BLM, 2015i). Figure 7.1.15-3 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Oregon, 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 June 2016, Oregon had 21 Priority 1 and 2 AMLs, with all problem areas funded and mitigated (DOI - Office of Surface Mining Reclamation and Enforcement, 2015a).



Figure 7.1.15-3: High Priority Abandoned Mine Lands in Oregon (2015)

Source: (Office of Surface Mining Reclamation and Enforcement 2015)

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near AMLs or mine fires, presenting occupational exposure risks from fire, toxic gases, and subsidence during FirstNet deployment, operation, and maintenance activities. Because the locations of many abandoned mines are unknown or hidden, these mines pose a risk to telecommunications workers because they may be encountered during deployment and maintenance operations.

Public Health and Safety

Subterranean mines present additional health and safety risks to the general public, by generating toxic combustible gases, which can penetrate the surface through ground fractures, potentially seeping into residential structures. Additionally, mine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and mine fires in particular, can result in evacuations of entire communities (DOI - Office of Surface Mining Reclamation and Enforcement, 2015b).

7.1.15.6. 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).

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, OBOLI and BLS do not report data specific to injuries or fatalities among telecommunication workers responding to natural or manmade disasters. However, the National Response Center (NRC), managed by the U.S. Coast Guard, compiles reports for oil spills, chemical releases, or other maritime security incidents and contains incident reports related to occupational health and safety. Of the 212 NRC-reported incidents for Oregon in 2015 with known causes, only 12 were attributed to natural disaster (e.g., earthquake, flood, hurricane, tornado, or other natural phenomenon); while 200 incidents were attributed to manmade disasters (e.g., derailment, disorderly passenger, dumping, equipment failure, operator error, over pressuring, suicide, transport accident, or trespasser) or other indeterminate causes (e.g., explosion, other, vessel sinking). For example, during the storms and flooding on December 3, 2007, storm damage caused transformer oil releases from pole-mounted transformers in three different areas, one of which released PCB-containing oil into a roadside ditch after a falling tree dislodged the pole-mounted transformer (U.S. Coast Guard, 2007). Such incidents present unique, hazardous challenges to telecommunication workers responding during natural or manmade disasters. (U.S. Coast Guard, 2015)

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, Oregon had 10 weather-related fatalities (1 due to flooding, 2 due to wind, and 7 due to unknown causes) and 12 non-fatal injuries. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015b)

7.2. 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.

7.2.1. Infrastructure

7.2.1.1. Introduction

This section describes potential impacts to infrastructure in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 7.2.1-1. As described in Section 7.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type,

including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 7.2.1-1: 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

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	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA
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 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.

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	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
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

7.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport or harbor operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination would be necessary with the relevant transportation authority (i.e., departments of transportation, airport authorities, railway companies, and harbormasters) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 7.2.1-1, 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 7.2.1-1, such potential negative and positive impacts would be less than significant.

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 7.2.1-1, 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 such beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus such infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of deployment activities.

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

Commercial assets would be using a different spectrum for communications; as such, commercial telecommunication systems, communications, or level of service would experience no impacts. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.¹⁴³ 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 activities proposed by FirstNet would have less than significant impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

7.2.1.4. Potential Impacts of the Preferred Alternative

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

¹⁴³ Telecommunications equipment for specific spectrum use can be built where other equipment for other spectrum use already exists. If the new equipment and spectrum is not fully utilized, the geographic region may experience "over-build," where an abundance of under-utilized equipment may exist in that geographic location. This situation can be caused by a variety of factors including changes in current and future use patterns, changes in spectrum allocation, changes in laws and regulations, and other factors.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to infrastructure and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure 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, and would not be expected to interfere with existing equipment. 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),¹⁴⁴ 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, other than harbor operations. 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.
 - **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

¹⁴⁴ Points of Presence are connections or access points between two different networks, or different components of one network.

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 composed of cellular base stations, sometimes with expandable antenna masts, and generators that connect to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however, this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be utilized but launched from existing paved surfaces; it is anticipated that there would be no impacts to infrastructure resources 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 the BMPs and

mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated 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 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 minimize disruptions and misinformation resulting from limited or disrupted service. 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.

7.2.1.5. 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 to avoid any negative impacts to such resources. Beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure as a result of

deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 7.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

7.2.2. Soils

7.2.2.1. Introduction

This section describes potential impacts to soil resources in Oregon associated with deployment and operation of the Proposed Action and Alternatives. 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.

7.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 7.2.2-1. As described in Section 7.1.2, 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 7.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that 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

7.2.2.3. *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 Oregon 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 Oregon that have steep slopes (i.e., greater than 20 percent) or where erosion potential is medium to high, including Albolls, Aquands, Aquents, Aquepts, Aquerts, Aquolls, Argids, Calcids, Cambids, Cryands, Cryepts, Cryods, Cryolls, Durids, Fluvents, Hemists, Humults, Orthents, Orthods, Udands, Udepts, Ustalfs, Vitrandis, Xeralfs, Xerands, Xerepts, Xererts, Xerolls, and Xerults suborders, which are found throughout most of the state (see Section 7.1.2.4, Soil Suborders and (Figure 7.1.2-2).

Based on the impact significance criteria presented in Table 7.2.2-1, 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 7.2.2-1, and due to the relatively small-scale (less than 1 acre) of most FirstNet project sites, as well as the implementation of BMPs and mitigation measures (Chapter 9), minimal topsoil mixing is anticipated.

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 7.1.2.3, Soil Suborders). The most compaction susceptible soils in Oregon are Albolls, Aquents, Aquepts, Aquerts, Aquolls, Hemists, and Orthods, which are found primarily in northern and western areas of the state (Figure 7.1.2-2). These soils constitute about 4.98 percent of Oregon's land

area¹⁴⁵. 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 7.2.2-1, 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.

7.2.2.4. *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 were 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

¹⁴⁵ This percentage was calculated by dividing the acres of soils that fall within the suborders listed above by the total soil land cover for the state.

phones, and video cameras, would not impact soil resources because those activities would not require ground disturbance.

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 and inland bodies of water could potentially impact soil resources at and near the landings or facilities on shores or the banks of waterbodies that accept submarine cable. Soil erosion and topsoil mixing could potentially occur as result of grading, foundation excavation, or other ground disturbance activities. Perceptible soil compaction and rutting could potentially occur due to heavy equipment use during these activities depending on the duration of the construction activity.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** 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 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 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 established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. These impacts are expected to be less than significant due to the temporary nature and small scale of operations activities with the potential to create 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.

7.2.2.5. 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 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 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 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to 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 7.1.2, Soils.

7.2.3. Geology

7.2.3.1. Introduction

This section describes potential impacts to Oregon geology resources associated with deployment and operation of the Proposed Action and Alternatives. 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.

7.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 7.2.3-1. As described in Section 7.2, 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 7.2.3-1: 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	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
Resources Impacts	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

7.2.3.3. 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 7.1.3, and shown in Figure 7.1.3-5, Oregon is at risk to significant earthquake events, particularly in the western portion of the state, due to its proximity to the Cascadia Subduction Zone. Based on the impact significance criteria presented in Table 7.2.3-1, seismic impacts from deployment or operation of the Proposed Action would have no impact on seismic activity; however, seismic impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within high-risk earthquake hazard zones. Given the potential for moderate to significant earthquakes in or near Oregon, 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

As discussed in Section 7.1.3, Oregon is at risk to significant volcanic events, particularly in southeastern Oregon, central Oregon, and particularly along the Cascade Mountain Range. Based on the impact significance criteria presented in Table 7.2.3-1, volcanic impacts would be less than significant where there is low likelihood that a project activity could be located near a volcanic ash area of influence. Given the potential for significant volcanic events in or near Oregon, some amount of infrastructure could be subject to volcanic 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.

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 7.1.3, much of western Oregon is at moderate to high risk of experiencing landslide events. Based on the impact significance criteria presented in Table

7.2.3-1, potential impacts to 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 avoid deployment in areas that are susceptible to landslide events. However, given that several of Oregon's major cities, including Portland, Corvallis, and Eugene, 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 or mine collapse, is subject to misalignment, alteration, or, in extreme cases, destruction. Significant long-term land subsidence, due to factors such as aquifer compaction, in coastal areas could lead to relative sea level rise¹⁴⁶ and inundation of equipment. All of these activities could result in connectivity loss.

As discussed in Section 7.1.3.8, portions of Oregon are vulnerable to land subsidence due to karst topography. Based on the impact significance criteria presented in Table 7.2.3-1, 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 avoid deployment in known areas of karst and pseudokarst topography. However, given that karst and pseudokarst topography exists in many counties throughout the state, some amount of infrastructure may be subject to subsidence hazards, in which case BMPs and mitigation measures would 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. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 7.2.3-1, impacts to mineral and fossil fuel resources are unlikely, as the Proposed Action could only be potentially significant if FirstNet's deployment locations were to cause severe, widespread, observable impacts to mineral and/or fossil fuel resources. To the extent practicable, FirstNet would avoid construction in areas where these resources exist. Chapter 9, BMPs and Mitigation Measures,

¹⁴⁶ Relative Sea Level Rise: "[Sea level rise that] includes the combined movement of both water and land. Even if sea level was constant, there could be changes in relative sea level. For example, a rising land surface would produce a relative fall in sea level, whereas a sinking land surface would produce a relative rise in sea level." (USGS, 2015e)

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 7.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 7.1.3.6, fossils are abundant throughout parts of Oregon. 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 should be considered on a site-by-site basis, and BMPs and mitigation measures could further 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.

Surface Geology, Bedrock, Topography, Physiography, and Geomorphology

Equipment installation and construction activities that degrade or alter surface geology, bedrock, or topography could cause measurable changes in physiographic characteristics of an area's geology, topography, physiography, or geomorphology. Based on the impact significance criteria presented in Table 7.2.3-1, 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.

7.2.3.4. 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, and other geologic hazards, it is possible that equipment could be affected by that hazard.

- New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water is not expected to impact geologic resources. However, where landings and/or facilities for submarine cable are installed at locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require ground disturbance in locations that are susceptible to geologic hazards (e.g., land subsidence, landslides, or earthquakes), it is possible that they could be affected by that hazard.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to geologic resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in erosion or disturbance of geologic resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in ground disturbance. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to geologic resources could occur due to ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
 - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to geologic resources depending on the technology and location

proposed for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs, or UAVs) occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. Where deployable technologies would be implemented on existing paved surfaces, there would be no impacts to/from geologic resources because there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards.

- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** In most cases, the installation of permanent equipment on existing structures, 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. Where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could result in incidental removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, volcanoes, landslides, and land subsidence). Specific FirstNet Proposed Actions are likely to be small-scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small-scale. As a result, these potential impacts are expected to be less than significant. 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 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. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to geology associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections because there would be no ground disturbance.

The operation of the Preferred Alternative could be affected by to geologic hazards including 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.3.5. 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 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 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 were subject to increased seismic activity, landslides, and land subsidence. 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.

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 7.1.3, Geology.

7.2.4. Water Resources

7.2.4.1. Introduction

This section describes potential impacts to water resources in Oregon associated with deployment and operation of the Proposed Action and Alternatives. 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.

7.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 7.2.4-1. As described in Section 7.2, 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 7.2.4-1: 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
Floodplain degradation ^a	Magnitude or Intensity	The use of floodplain fill, substantial increases in impervious surfaces, or placement of structures within a 500-year flood area that will impede or redirect flood flows or impact floodplain hydrology. High likelihood of encountering a 500-year floodplain within a state or territory.	Effect that is potentially significant, but with 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.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		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
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

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Changes in groundwater or aquifer characteristics	Magnitude or Intensity	Substantial and measurable changes in groundwater or aquifer characteristics, including volume, timing, duration, and frequency of groundwater flow, and other changes to the groundwater hydrologic regime.	Effect that is potentially significant, but with 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

^a Since public safety infrastructure is considered a critical facility, project activities should avoid the 500-year floodplain wherever practicable, per the Executive Orders on Floodplain Management (EO 11988 and EO 13690). (See <http://www.archives.gov/federal-register/codification/executive-order/11988.html> and <https://www.federalregister.gov/articles/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and>).
 NA = Not Applicable

7.2.4.3. *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 404(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

As of 2006, most of Oregon's assessed surface waterbodies were impaired (see Table 7.1.4-2, Figure 7.1.4-2). Main causes of impairment include temperature, nutrients, habitat modification, and fecal coliform. No probable sources for impairment were listed on the USEPA website (USEPA, 2006). Nearly a decade later, water quality in Oregon had improved. "Overall, 51 percent of river sites monitored were found to have excellent to good water quality status" (Oregon DEQ, 2015g).

Deployment activities could contribute pollutants in a number of ways but the primary likely manner is increased sediment in surface waters. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a Storm Water Pollution Prevention Plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs could reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, SDWA), and local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality. Therefore, based on the impact significance criteria presented in Table 7.2.4-1, 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 trenching¹⁴⁷ 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 Oregon dewatering requirements. Any groundwater extracted during dewatering activities, or subject to the terms of a dewatering permit, may be required to be treated prior to discharge or disposed of at a wastewater treatment facility.

Due to average thickness of most Oregon's aquifers, there is little potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifers, and based on the impact significance criteria presented in Table 7.2.4-1, 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, 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 hazard, where there is a 0.2-percent annual chance of flooding. 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 7.2.4-1, 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, structures would not impede or redirect flood flows or impact floodplain hydrology, and would not occur during flood events with the exception of deployable technologies which may be deployed in response to an emergency. Additionally, any

¹⁴⁷ 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).

effects would be temporary, lasting no more than one season or water year,¹⁴⁸ 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 change drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 7.2.4-1, 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 offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant impacts.

¹⁴⁸ A water year is defined as “the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.” (USGS, 2016d)

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 7.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs, mitigation measures, and avoidance could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 7.1.4.7, approximately 70 percent of Oregon residents get their drinking water from groundwater, and over 90 percent of the state's public water systems get their drinking water from groundwater. Generally, the water quality of Oregon's aquifers is suitable for drinking and daily water needs. (Oregon DEQ, 2015h) Groundwater is an important natural resource used by industrial, commercial, agricultural, and residential uses for manufacturing, irrigation, and drinking water purposes. Once a groundwater supply is exhausted or contaminated, it is very expensive, and sometimes impossible, to replace. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would be unlikely to cause significant impacts to water quality due to the expected small volume of these materials. Activities that may cause changes in groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.

Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities should be less than significant 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 7.2.4-1, 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.

7.2.4.4. 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 and inland bodies of water would impact water resources from a short-term increase in suspended solids in the water. Site-specific impact assessment could 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. Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
 - 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be less than significant 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 rights-of way. 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.4.5. 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, would likely be a few gallons or less in volume and would likely be easily contained or cleaned up, and therefore would have less than significant impacts. 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 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 established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the

condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies; however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to 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 7.1.4, Water Resources.

7.2.5. Wetlands

7.2.5.1. Introduction

This section describes potential impacts to wetlands in Oregon associated with deployment and operation of the Proposed Action and Alternatives. 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.

7.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 7.2.5-1. As described in Section 7.2, 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 7.2.5-1: 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	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
degradation (spills or sedimentation)	Duration or Frequency	Long-term or permanent alteration that is not restored within 2 growing seasons, or ever.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Indirect effects: ^b change in function(s) ^c change in wetland type	Magnitude ^a or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No changes in wetland function or type.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Long-term or permanent.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA

^a "Magnitude" is defined based on the type of wetland impacted, using USACE wetland categories (USACE 2014). Category 1 are the highest quality, highest functioning wetlands.

^b Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type.

^c Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

NA = Not Applicable

7.2.5.3. *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).

There are more than 1.5 million acres of wetlands throughout Oregon (USFWS, 2014g). In Oregon, the main type of wetlands are palustrine (freshwater) wetlands found on river and lake floodplains across the state as shown in Figure 7.1.5-1. Palustrine wetlands comprise approximately 92 percent of the wetlands in the state. Estuarine/marine (tidal) wetlands occur along the Pacific Ocean coastline, comprise approximately two percent of the total wetlands in the state. Riverine and lacustrine wetlands, which occur throughout the state, comprise approximately four percent and two percent of the total wetlands in the state, respectively. (USFWS, 2014g)

Based on the impact significance criteria presented in Table 7.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, the deployment activities would not violate applicable federal, state, and local regulations.

In Oregon, as discussed in Wetlands, Section 7.1.5.4, regulated high quality wetlands include bogs, fens, wetlands in dunal systems along the Oregon coast, vernal pools, alkali wetlands, and Willamette Valley wet prairie wetlands (USACE - Portland, 2015). If any of the proposed deployment activities were to occur in high quality wetlands, potentially significant impacts could occur. High quality wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would be required, in addition to BMPs and

mitigation measures to avoid potentially significant impacts to 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 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 7.2.5-1, 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. In addition, introduction and establishment of invasive species to high quality wetlands within a watershed or multiple watersheds are potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, 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 Oregon 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, such as the acidic conditions of sphagnum bogs and alkaline conditions of calcareous fens (which are high quality wetlands in Oregon).
- *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:¹⁴⁹ Change in Function(s)¹⁵⁰ 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 Oregon 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.

¹⁴⁹ 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.

¹⁵⁰ Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of oxygen-demanding materials and reduce fecal coliform populations. These pollutants are often then buried by newer plant material, isolating them in the sediments.
- *Wildlife Habitat:* Impacts on wetland hydrology and water quality affect wetland vegetation. While flooding could harm some wetland plant species, it promotes others. Shifts in plant communities because of hydrologic changes could have impacts on the preferred food supply and animal cover.
- *Recreational Value:* Wetlands provide recreation opportunities for people, such as hiking, bird watching, and photography.
- *Groundwater Recharge:* Wetlands retain water, allowing time for surface waters to infiltrate into soils and replenish groundwater.

According to the significance criteria defined in Table 7.2.5-1, 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. Since the majority of the wetlands in Oregon are not considered high quality, deployment activities could have less than significant indirect impacts on wetlands in the state. In areas of the state with high quality wetlands, there could be potentially significant impacts at the project level that would be analyzed on a case-by-case basis. If avoidance were not possible, BMPs and mitigation measures would help to mitigate impacts. 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.

7.2.5.4. *Potential Impacts of the Preferred Alternative*

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations could be required to determine the exact location of all wetlands, including high quality wetlands, as well as a functional assessment by an experienced wetland delineator.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wetlands and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to potentially significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to wetlands under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to wetlands since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have no impacts on wetlands because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, adding equipment to satellites being launches for other purposes, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would 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 (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity

- to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water would potentially impact wetlands found along shorelines. Additional project-specific environmental reviews would be required to assess potential impacts to wetland environments, including coastal and marine environments.
 - New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts to wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
 - Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
 - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- **Deployable Technologies:** Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of drones, balloons, 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 (e.g., high quality). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant due to the small amount of land disturbance (generally less than one acre) and the short timeframe of deployment activities. 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.

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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.5.5. 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 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 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 7.1.5, Wetlands.

7.2.6. Biological Resources

7.2.6.1. Introduction

This Chapter describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Oregon associated with deployment and operation of the Proposed Action and its Alternatives. 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.

7.2.6.2. 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 7.2.6-1. As described in Section 7.2, 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 7.2.6.3, 7.2.6.4, and 7.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 7.2.6.6 for impact assessment methodology and significance criteria associated with threatened and endangered species in Oregon.

Table 7.2.6-1: Impact Significance Rating Criteria for Terrestrial Vegetation, Wildlife, Fisheries, and Aquatic Habitats

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct Injury/Mortality	Magnitude or Intensity	Population-level or sub-population injury/mortality effects observed for at least one species depending on the distribution and the management of said species. Events that may impact endemics, or concentrations during breeding or migratory periods. Violation of various regulations including 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 Oregon for at least one species. Anthropogenic ^a disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Vegetation and Habitat Loss, Alteration, or Fragmentation	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species or vegetation cover type, depending on the distribution and the management of the subject species. Impacts to terrestrial, aquatic, or riparian habitat or other sensitive natural community vital for feeding, spawning/breeding, foraging, migratory rest stops, refugia, or cover from weather or predators. Violation of various regulations including: 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 Oregon for at least one species. Anthropogenic disturbances that lead to the loss or alteration of nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Indirect Injury/Mortality	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Exclusion from resources necessary for the survival of one or more species and one or more life stages. Anthropogenic disturbances that lead to mortality, disorientation, the avoidance, or exclusion from nutritional or habitat resources for endemics or a significant portion of the population or sub-population located in a small area during a specific season. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is 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 Oregon for at least one species. Behavioral reactions to anthropogenic disturbances depend on the context, the time of year age, previous experience, and activity. Anthropogenic disturbances that lead to startle responses of large groupings of individuals during haulouts, resulting in injury or mortality.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Effects to Migration or Migratory Patterns	Magnitude or Intensity	Population-level or sub-population effects observed for at least one species depending on the distribution and the management of said species. Temporary or long-term loss of migratory pattern/path or rest stops due to anthropogenic activities. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is 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 Oregon for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Oregon for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning, stress, abandonment and loss of productivity for endemics or a significant portion of the population or sub-population located in a small area during the breeding/spawning season.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Oregon.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

^a Anthropogenic: “Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities” (USEPA, 2016d).

NA = Not Applicable

7.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Oregon 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 7.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Although unlikely, direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, FirstNet deployment events are expected to be relatively small in scale and therefore would have less than significant impacts. The implementation of standard BMPs, 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the potential impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. In Oregon, 8.6 percent of the total land cover is agricultural land (USGS, 2011) and about 53 percent is federal land (USGS, 2012d) (USGS, 2014g). Additionally, about 44.9 percent of the land cover in the state is forest, primarily in the western half of the state (USGS, 2011).

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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment. Overall, these impacts are expected to be less than significant due to the short-term and small-scale nature of deployment activities. 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.

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 Oregon Department of Agriculture (ODA) Noxious Weed Control Program provides statewide coordination and management of state listed noxious weeds designated under ORS 569.615 (ADA 2015). Although there is no policy related to the prohibition of noxious weeds in Oregon, there are policies in place to prevent the establishment and spread of listed noxious weeds.

As described in Section 7.1.6.4, 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 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 the BMPs and mitigation measures that

FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology¹⁵¹, 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.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to terrestrial vegetation under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although terrestrial vegetation could be impacted, it is anticipated that effects to vegetation would be minimal since the activities that would be conducted at these small entry and exit points are not likely to produce perceptible changes.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have no impacts on terrestrial vegetation because there would be no ground disturbance.
- **Satellites and Other Technologies**
 - **Satellite-Enabled Devices and Equipment:** It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not

¹⁵¹ Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

impact terrestrial vegetation because those activities would not require ground disturbance.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact biological resources, it is anticipated that this activity would have no impact on terrestrial vegetation.

Activities with the Potential to Have Impacts

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 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 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 if BMPs and mitigation measures are not implemented.
 - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
 - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore or inland bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on 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 if BMPs and mitigation measures are not implemented.

- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct or indirect injury to plants, vegetation loss, and invasive species effects.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
 - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. These 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 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, 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts 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. See Chapter 9, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant. 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to terrestrial vegetation as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 7.1.6.3, Terrestrial Vegetation.

7.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates occurring in Oregon and Oregon's near offshore environment (i.e., less than two miles from the edge of the coast) are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle or vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 7.2.6-1, less than significant impacts would be anticipated at the programmatic level given that the majority of proposed deployment

activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet 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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Oregon. 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-scale and would be dependent on the location and type of deployment activity, and tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Marine Mammals

Marine mammals swimming or hauled out on land are sensitive to boats, aircraft, and human presence. Noises, smells, sounds, and sights may elicit a flight reaction. Trampling deaths associated with haulout disturbance are known source of mortality for seals but are not anticipated from likely FirstNet deployment activities.

Entanglements from marine debris as well as ingestion of marine debris could result in injury or death to marine mammals. Marine debris is any manmade object discarded, disposed of, or abandoned that enters the marine environment. Entanglements from marine debris are not anticipated from FirstNet activities.

Birds

Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species. Generally, collision events occur to night-migrating birds, “poor” fliers (e.g., ducks), heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans (FAA 2012; Gehring, J., Kerlinger, P. and Manville, A. M. 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 if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, 1997).

Direct mortality and injury to birds of Oregon 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, 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 Oregon's amphibian and reptile species are widely distributed throughout the state; however, some species have more limited ranges. Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Three species of marine turtles – all listed as threatened or endangered under the ESA – occur in Oregon's offshore environment. Environmental consequences pertaining to these reptiles are discussed in Section 7.2.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Oregon 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. In Oregon, 8.6 percent of the total land cover is agricultural land (USGS, 2011) and about 53 percent is federal land (USGS, 2012d) (USGS, 2014g).

Additionally, about 44.9 percent of the land cover in the state is forest, primarily in the western half of the state (USGS, 2011).

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 for Oregon's wildlife species below. 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.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Oregon and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals (e.g., black bear) by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals (e.g., bats, foxes) that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by BMPs and mitigation measures (see Chapter 9).

Marine Mammals

Common marine mammals observed in Oregon waters include seals, sea lions, whales, and dolphins (ODFW, 2016m). Seals can be found in open waters and also using rocks, beaches or other coastal habitats (ODFW, 2016m). Seals could be temporarily excluded from a resource due to the presence of humans, noise, or vessel traffic during deployment activities. For example, the seals would need to find a new shore habitat, likely at a less favorable location. Effects on seals from exclusion from resources would be low magnitude and temporary in duration.

Loss of habitat or exclusions from these areas for marine mammals could be avoided or minimized by BMPs and mitigation measures (see Chapter 9), as appropriate.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and the ODFW provide regional guidance on the most critical time periods (e.g., breeding season) to avoid vegetation clearing. The removal and loss of vegetation could affect avian species directly by loss of nesting, foraging, stopover, and cover habitats.

Noise 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, D. et al. 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine¹⁵² species from disturbance or displacement from construction activities is likely to be short-term with minor effects from exclusion. Exclusion from resources concentrated in a small migratory stop area during peak migration could have major impacts to species that migrate in large flocks and concentrate at stopovers (e.g., shorebirds). BMPs and mitigation measures, including nest avoidance during construction-related activities, could help to avoid or minimize the potential impacts to birds from exclusion of resources, as appropriate.

Reptiles and Amphibians

Important habitats for Oregon's amphibians and reptiles typically consist of wetlands and the surrounding upland forest. 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) would be implemented to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 7.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects to Oregon's amphibian and reptile populations, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.¹⁵³

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 7.2.6.6, Threatened and Endangered Species and Species of Conservation 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 further help to 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.

¹⁵²Passerines 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.

¹⁵³ See Section 7.2.5, Wetlands, for a discussion of BMPs for wetlands.

Terrestrial Mammals

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature and repeated disturbances would not occur.

Marine Mammals

Repeated disturbance (e.g., from vessel traffic) could cause stress to individuals resulting in lower fitness and productivity. Given that the majority of FirstNet deployment activities are not expected to be located onshore or in the oceanic environment, less than significant impacts to no impacts would be anticipated for marine mammals.

Birds

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state. The majority of FirstNet deployment activities would be short-term in nature and repeated disturbances would not occur.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature and repeated disturbances would not occur.

Terrestrial Invertebrates

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Overall, potential impacts are anticipated to be less than significant due to the small-scale and localized nature of expected activities. Potential effects to migration patterns of Oregon's amphibians and reptiles, terrestrial mammals, marine mammals, birds, and terrestrial invertebrates are described below. 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.

Terrestrial Mammals

Some large mammals (e.g., black bears) will perform seasonal migrations between foraging/breeding habitats and denning habitats. Some small mammals (e.g., bats) also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.¹⁵⁴

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.

Marine Mammals

Noise associated with the installation of cables in the near/offshore waters of coastal Oregon could impact marine mammal migration patterns, though impacts are likely to be short-term provided the noise sources are not wide ranging and below Level A and B sound exposure thresholds.¹⁵⁵ It is clear that behavioral responses are strongly affected by the context of exposure and by the animal's experience, motivation, and conditioning. Marine mammals have the capacity to divert from sound sources during migration, and therefore impacts are expected to be less than significant since noise generating activities would be of short duration and are not likely to result in long-term avoidance. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, as a group, shorebirds migrating through Oregon undertake some of the longest-distance migrations of all animals. Oregon is within the Pacific Flyway, and has 97 IBAs throughout the state serving as important stopover, breeding, and wintering areas for migratory birds (Audubon Society of Portland 2015). Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significant given the 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.

¹⁵⁴ A location chosen by an animal for hibernation.

¹⁵⁵ Level A: 190 dB re 1 μ Pa (rms) for seals and 180 dB re 1 μ Pa (rms) for whales, dolphins, and porpoises. It is the minimum exposure criterion for injury at the level at which a single exposure is estimated to cause onset of permanent hearing loss. Level B: 160 dB re 1 μ Pa (rms). It is defined as the onset of significant behavioral disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (Southall, et al., 2007)..

Reptiles and Amphibians

Several species of salamanders and frogs are known to seasonally migrate in Oregon. Post-metamorphic salamanders, such as the blotched tiger salamander, migrate out of the ponds where they were born and into the uplands where they live until they move back to ponds to breed as adults (ODFW, 2016n). Mortality and barriers to movement could occur as result of the Proposed Action (Berven & Grudzien 1990; Calhoun & DeMaynadier 2007).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but impacts are expected to be less than significant 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 Oregon'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 anticipated to be less than significant due to the short-term and limited nature of expected activities. 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.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and dens for large mammals, such as the black bear, has the potential to negatively affect body condition and reproductive success of mammals in Oregon.

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.

Marine Mammals

Although unlikely, the displacement of female seals from preferred pupping habitats due to deployment and operations may reduce fitness and survival of pups potentially affecting overall productivity. However, activities are likely to be small-scale in nature and contribute only minimally to minor, short-term displacement, and BMPs and mitigation measures could help to avoid or minimize the potential impacts.

Disturbance to hauled out seals from activities associated with the Proposed Action could result in the abandonment, or death of offspring, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual 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 7.2.6.6, Threatened and Endangered Species.

Reptiles and Amphibians

Reproductive effects to reptile nests may occur through direct loss or disturbance of nests. For example, the western painted turtle (*Chrysemys picta*) lays its eggs on open soil (ODFW, 2016o).

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. ODFW monitors and works to control the spread of invasive wildlife species in Oregon. Although several wildlife species are considered invasive (such as the opossum), the feral swine is the only wildlife species actively controlled by the state.

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 Oregon's wildlife are described below.

Terrestrial Mammals

In Oregon, feral swine adversely impact several native wildlife and vegetation. They feed on young mammals, destroy native vegetation resulting in erosion and water resource concerns, and could carry/transmit disease to livestock and humans (ODFW, 2016p).

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.

Marine Mammals

Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water; therefore, the introduction of non-native species would not occur.

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 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 deployment activities. Invasive terrestrial reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers.

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 threat to Oregon's forest and agricultural resources. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. 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 construction/deployment and operational activities.

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to wildlife resources and others would not. In addition, and as described in this section, infrastructure developed under the Preferred Alternative could result in a range of impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The wildlife that would be affected would depend on the ecoregion, the species' phenology and the nature and extent of the habitats affected. 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.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to wildlife resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to wildlife resources include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to wildlife resources. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities could result in direct injury/mortalities of wildlife that are not mobile enough to avoid construction activities (e.g., reptiles, small mammals, and young individuals), that utilize burrows (e.g., ground squirrels), or that are defending nest sites (such as ground-nesting birds). Disturbance, including noise, associated with the above activities involving heavy equipment or land clearing could result in habitat loss, effects to migration patterns, indirect injury/mortality, reproductive effects, and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
 - **New Build – Aerial Fiber Optic Plant:** The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individuals as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited nearshore or inland bodies of water and construction of landings and/or facilities on the shores or the banks of waterbodies that accept submarine cables could potentially impact wildlife, marine mammals in particular (see Section 7.2.4, 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, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant at the programmatic level given the small scale of likely individual FirstNet projects; 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, and are therefore expected to remain less than significant at the programmatic level. Proposed FirstNet actions at specific individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. 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 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, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources at the programmatic level associated with routine inspections and maintenance of the Preferred Alternative. Site inspections and 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 be less than significant at the programmatic level given the short-term nature and limited geographic scope for individual activities. 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.

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 at the programmatic level because deployment activities are expected to be temporary and localized, likely affecting only a small number of wildlife. 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.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts at the programmatic level because deployable activities are expected to be temporary and likely affecting only a small

number of wildlife. Proposed FirstNet actions at specific individual sites may have a higher level of impacts due to location-specific conditions, and therefore those proposed activities would undergo site-specific environmental review. The impacts could vary greatly among species and geographic region. 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.

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 7.1.6.4, Terrestrial Wildlife.

7.2.6.5. Fisheries and Aquatic Habitats

Impacts to fisheries and aquatic habitats occurring in Oregon and its near offshore environment 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, 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 7.2.6-1, less than significant impacts would be anticipated at the programmatic level given the majority of proposed deployment activities are likely to be small-scale and would be dependent on the location and type of deployment activity. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity. Additionally, deployment activities with the potential for impacts under the MSFCMA or other sensitive aquatic habitats could be addressed through BMPs and mitigation measures as defined through consultation with the appropriate resource agency.

Indirect Injury/Mortality

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 the short-term nature and limited geographic scope of deployment activities. BMPs and mitigation measures to protect water resources (see Section 7.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts would vary depending on the species, time of year, and duration of deployment, but would be localized and small-scale, and therefore are expected to be less than significant. 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 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, impacts are anticipated to be less than significant. BMPs and mitigation measures could help to avoid or minimize the potential for introducing invasive aquatic plant and animal species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. 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 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 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 facilities to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
 - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could, if conducted near water resources that support fish, result in habitat loss, alteration and fragmentation; 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 at the programmatic level 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 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, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated, at the programmatic level, that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance activities that may 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 at the programmatic level due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 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.

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 at the programmatic level due to the limited nature of expected deployment activities. 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.

Operational Impacts

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 the BMPs and mitigation measures that FirstNet and/or its partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the 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 7.1.6.5, Fisheries and Aquatic Habitats.

7.2.6.6. *Threatened and Endangered Species*

This section describes potential impacts to threatened and endangered species in Oregon and Oregon's offshore environment associated with deployment and operation of the Proposed Action and Alternatives. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

7.2.6.7. *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 7.2.6-2. 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 7.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	May Affect, Not Likely to Adversely Affect	No Effect
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Includes 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.	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 Characteristics	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 7.2.6-2, 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 Oregon 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.

Terrestrial Mammals

Two endangered and one threatened terrestrial mammal species are federally listed and known to occur in the state of Oregon; they include the Canada lynx, Columbian white-tailed deer, and gray wolf.

Direct mortality to the federally listed Canada lynx, Columbian white-tailed deer, or gray wolf could occur from vehicle strikes, as these species are occasionally found along transportation corridors. Entanglement in fences or other barriers could also be a source of mortality or injury to these species. Impacts would likely be isolated, individual events and therefore may affect, but are not likely to adversely affect, a listed species.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Birds

One endangered and five threatened bird species are federally listed and known to occur in the state of Oregon; they include the marbled murrelet, northern spotted owl, short-tailed albatross, streaked horned lark, yellow-billed cuckoo, and western snowy plover. Depending on the project types and location, direct mortality or injury to these birds could occur from collisions or electrocutions with manmade cables and wires, vehicle strikes, or by disturbance or destruction of nests during ground disturbing activities. However, these potential impacts may affect, but are not likely to adversely affect, listed species as FirstNet would attempt to avoid deployment activities in these areas. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures, as defined through consultation with the appropriate resource agency,

would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

One threatened amphibian species is federally listed and known to occur in the state of Oregon; the Oregon spotted frog. Direct mortality to the species could occur in construction zones either by excavation activities or by vehicle strikes. Potential effects would likely be isolated, individual events, and FirstNet would attempt to avoid areas where the species may occur. Therefore, potential impacts may affect, but would not likely adversely affect, the listed species.

Three federally listed marine reptiles, two endangered and one threatened, are known to occur in the coastal area and offshore environment of Oregon. They are the leatherback sea turtle, loggerhead sea turtle, and the Olive ridley sea turtle. The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury occurring from watercraft and vessels strikes are unlikely as the majority of the FirstNet deployment projects would not occur in an aquatic environment. Therefore, potential impacts may affect, but would not likely adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Fish

Four endangered and nine threatened fish species are federally listed and known to occur in the state of Oregon, as presented in Section 7.1.6.6 and Table 7.1.6-9; this is inclusive of four evolutionarily significant units of Chinook salmon and four distinct population segments of steelhead trout. Direct mortality or injury to this species could occur from entanglements resulting from the Proposed Action, but are unlikely as the majority of FirstNet deployment projects would not occur in 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.

Invertebrates

Two endangered and two threatened invertebrate species are federally listed and known to occur in the state of Oregon; they are the Fender's blue butterfly, Oregon silverspot butterfly, Taylor's checkerspot, and vernal pool fairy shrimp. Direct mortality or injury could occur to the Fender's blue butterfly, Oregon silverspot butterfly, or Taylor's checkerspot if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid areas where these species may occur.

The majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to the vernal pool fairy shrimp are unlikely but could occur from changes in water quality from ground disturbing activities causing stress and lower productivity resulting

from the Proposed Action. Potential impacts may affect, but are not likely to adversely affect, the listed 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

Eleven endangered and nine threatened plants species are federally listed and known to occur in the state of Oregon as summarized in Table 7.1.6-13. Direct mortality to federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action occur in an area inhabited by one of these species. FirstNet would attempt to avoid areas where these species may occur; therefore, potential impacts may affect, but are not likely to adversely affect, listed 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, and marine reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Oregon 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 that 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

Noise, light, or human disturbance within nesting areas could cause federally listed birds, such as the yellow-billed cuckoo, to abandon their nests or relocate to less desirable locations, or may result in stress to individuals, reducing survival and reproduction. FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures,

as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Changes in water quality, especially during the breeding seasons, resulting from ground disturbing activities could cause stress to federally listed species, such as the Oregon spotted 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 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.

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 7.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to reproduction of the federally listed fish species in Oregon are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment and FirstNet would attempt to avoid these areas. Therefore, potential impacts may affect, but are not likely to adversely affect, listed species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 vernal pool fairy shrimp. The introduction of invasive plants to habitats utilized by federally listed butterfly species could potentially affect these species, such as the silverspot butterfly that relies on a single plant for completion of its lifecycle (Oregon Zoo, 2016). Potential impacts to federally listed invertebrate species may affect, but are not likely to adversely affect, those species, as FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Plants

Potential impacts could occur from ground-disturbing activities to listed plant species as a result of the Proposed Action. However, FirstNet would attempt to avoid these areas. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency,

would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Oregon are described below.

Mammals

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 Oregon. 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 are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over distances often involving many different countries. For example, 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 are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

Habitat loss or alteration, particularly from fragmentation or invasive species, could affect nesting and foraging sites of the federally listed reptile species, resulting in reduced survival and

productivity; however, the localized nature of disturbances during deployment activities are not anticipated to stress federally listed reptiles or amphibians. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these 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

Changes in water quality as a result of ground disturbing activities could impact food sources for the four endangered and nine threatened fish species in Oregon. 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 listed species are unlikely as the majority of FirstNet deployment projects would not occur in aquatic environment. Therefore, potential impacts may affect, but are not likely to adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Changes in water quality, habitat loss or alternation, and introduction of aquatic invasive species could impact food sources for federally listed crustaceans resulting in lower productivity. Disturbances to food sources utilized by the federally listed terrestrial species, especially during the breeding season, could impact foraging behavior. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, these species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Plants

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extent. In some cases, large-scale impacts could occur that would not diminish the functions and values of the habitat, while in other cases, small-scale changes could lead to potentially significant adverse effects., such as impacts to designated critical habitat for a listed species that is only known to occur in one specific location

geographically. Potential effects to federally listed birds, reptiles and amphibians, fish, invertebrates, and plants with designated critical habitat in Oregon are described below.

Terrestrial Mammals

No designated critical habitat occurs for terrestrial mammals in Oregon. Therefore, no effect to threatened and endangered species from the loss or degradation of designated critical habitat is expected as a result of the Proposed Action.

Birds

Four of the federally listed bird species in Oregon have federally designated critical habitat. Critical habitat for the marbled murrelet was designated in Grants Pass, Oregon. Critical habitat for the northern spotted owl consists of six units in the western half of Oregon. Critical habitat for the streaked horned lark was designated in Clatsop, Columbia, Marion, Polk, and Benton Counties. Critical habitat for the western snowy plover has been designated in Clatsop, Tillamook, Lane, Douglas, Coos, and Curry Counties. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

No critical habitat has been designated for the other two 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

Critical habitat has been designated for the leatherback sea turtle along the coast of California, Oregon and Washington (NMFS, 2012). Critical habitat for the Oregon spotted frog is proposed to be 53,866 acres in Deschutes, Jackson, Klamath, Lane, and Wasco Counties (USFWS, 2013f). FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Fish

Ten of the federally listed fish species in Oregon have federally designated critical habitat. Critical habitat for the Borax lake chub was designated in the Borax Lake area in Harney County. Critical habitat for the bull trout was designated in 22 counties throughout Oregon. Critical habitat for the Chinook salmon, chum salmon, coho salmon, sockeye salmon, and steelhead was designated as all river reaches within the distinct population segments accessible to these species in Oregon. Critical habitat for the Lost River sucker consists of lakes and reservoirs in Klamath and Lake Counties. Critical habitat for the shortnose sucker consists of

streams in Klamath and Lake Counties. Critical habitat for the Warner sucker was designated as Snyder Creek, Honey Creek, and the spillway canal north of Hart Lake. Proposed FirstNet deployment activities near water would likely occur onshore with limited activities in the water and therefore would not likely disturb critical habitat. FirstNet would attempt to avoid areas where these species are known to occur; therefore, 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 three federally listed fish 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.

Invertebrates

All four of the federally listed invertebrate species in Oregon have federally designated critical habitat. Critical habitat for the Fender's blue butterfly was designated in Benton, Lane, Polk, and Yamhill Counties. Critical habitat for the Oregon silverspot butterfly was designated in Lane County. Critical habitat for the Taylor's checkerspot was designated in Benton County. Critical habitat for the vernal pool fairy shrimp was designated in Jackson County. Land clearing, excavation activities, and other ground disturbing activities in these regions of Oregon could lead to habitat loss or degradation, which could affect these invertebrates depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, potential impacts may affect, but would likely not adversely affect, designated critical habitat. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Plants

Eight of the federally listed plant species in Oregon have federally designated critical habitat. Critical habitat for the Cook's lomatium was designated in Jackson and Josephine Counties. Critical habitat for the Hoover's spurge was designated in Jackson County. Critical habitat for the Kincaid's lupine was designated in Benton, Lane, Polk, and Yamhill Counties. Critical habitat for the large-flowered woolly meadowfoam was designated in Jackson County. Critical habitat for the Malheur wire-lettuce was designated in Harney County. Critical habitat for the Willamette daisy was designated in Benton, Lane, Linn, Marion, and Polk Counties. Greene's Tuctoria has designated critical habitat in Lake and Klamath Counties.

Land clearing, excavation activities, and other ground disturbing activities in these regions of Oregon could lead to habitat loss or degradation, which affect these plants depending on the duration, location, and spatial scale of the associated activities. FirstNet would attempt to avoid areas where these species are known to occur; therefore, 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 federally listed plant 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.

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. 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 Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect 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 if 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., small mammals and young), 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 7.2.4, 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 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, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.

- **Deployable Technologies:** Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise 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 are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to threatened and endangered species as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies may affect, but is not likely to adversely affect, threatened and endangered species through direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 9, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred

Alternative, it is anticipated that activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. FirstNet would attempt to avoid areas where these species are known to occur. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 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 7.1.6.6, Threatened and Endangered Species.

7.2.7. Land Use, Recreation, and Airspace

7.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.7.2. 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 7.2.7-1. As described in Section 7.2, 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 7.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Direct land use change	Magnitude or Intensity	Change in designated/permitted land use that conflicts with existing permitted uses, and/or would require a change in zoning. Conversion of prime or unique agricultural lands.	Effect that is 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 BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Loss of access to public or private recreation land or activities	Magnitude or Intensity	Total loss of access to recreation land or activities.	Effect that is 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 BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Use of airspace	Magnitude or Intensity	Measurable, substantial change in flight patterns and/or use of airspace.	Effect that is 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

7.2.7.3. 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 aboveground facilities or assets could have short- or long-term effects to existing development or land use based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in land use. The effects from these actions would depend on the geographic location; compatibility with existing land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could change the existing land use to another category or result in the short- or long-term loss of the existing land use.

Based on the impact significance criteria presented in Table 7.2.7-1, 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 7.2.7-1, 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 7.2.7-1, 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 7.2.7-1, 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 7.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. As drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, FirstNet would not have a significant impact on airspace resources.

7.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action, 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.
 - 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*. (See Section 7.1.7.5 Obstructions to Airspace Considerations).
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
 - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: See *Activities with the Potential to Have Impacts* below.
 - Airspace: 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 7.1.7.5, 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 collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
 - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
 - Recreation: Use of existing dark 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 construction of 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 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 7.1.7.5, 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 7.1.7.5 Obstructions to Airspace Considerations.
- Satellites and Other Technologies
 - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.

- Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
- Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
- Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, recreation, or airspace, it is anticipated that this activity would have no impact on land use, recreation, or 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 and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
 - Airspace: No impacts are anticipated – see previous section.
 - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
 - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
 - Airspace: No impacts are anticipated – see previous section.
 - Wireless Projects
 - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
 - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access

- roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
- Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
 - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets other criteria listed in Section 7.1.7.6. 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 Oregon'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 Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to 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 7.2.8, 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to land use, recreation, and airspace resources as a result of implementation of this Alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to land use. While a single deployable technology may have imperceptible impact, multiple technologies operating in close proximity for longer periods could impact existing and surrounding land uses. There could be impacts to recreation activities during the deployment of technologies if such deployment were to occur within or near designated recreation areas. Enjoyment of activities dependent upon the visibility of wildlife or scenic vistas may be affected; however, impacts would be less than significant 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 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 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 7.1.7, Land Use, Recreation, and Airspace.

7.2.8. Visual Resources

7.2.8.1. Introduction

This section describes potential impacts to visual resources in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 7.2.8-1. As described in Section 7.2, 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 7.2.8-1: 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.

7.2.8.3. 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 Oregon, residents and visitors travel to many national monuments, historic sites, and state parks, such as Mount Hood recreation area to view its scenic vistas while hiking and camping. 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.

Oregon regulates impacts to visual resources for historic properties through their SHPO to ensure the state's historic resources are registered in the state register and NRHP (Oregon.gov, 2015f). The Oregon Department of Parks and Recreation administers historic sites when they are contained within the state's park system (OPRD, 2016b). Historic properties in Oregon are assessed prior to a proposed project to determine if any adverse effects to the integrity or historic significance could occur.

Based on the impact significance criteria presented in Table 7.2.8-1, 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 7.2.8-1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term could be considered potentially significant. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience potentially significant impacts to night skies, although potentially minimized 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.

7.2.8.4. 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, 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 was 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 was 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 lighting.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant, due to the temporary and small-scale nature of deployment activities. As discussed above, potential impacts to night skies from lighting are expected to be less than significant with BMPs and mitigation measures incorporated. 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.

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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.8.5. 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 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 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 7.1.8, Visual Resources.

7.2.9. Socioeconomics

7.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 7.2.9-1. As described in Section 7.2, 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 7.2.9-1: 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 tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with 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

7.2.9.3. 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 Oregon. Median values of owner-occupied housing units in the 2009–2013 period ranged from over \$279,000 in the greater Portland area (Oregon portion), to just over \$140,000 in the Klamath Falls/Altamont 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 contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to \$7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary user to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. It is also highly unlikely that these impacts would lead to significant market shifts or other significant changes to local/regional economic structure.

Spending and income generation related to developing the NPSBN would also result in changes to public revenues. Property taxes may change as property values increase or decrease due to the installation of new infrastructure. General and selective sales taxes may change (most likely increase), reflecting expenditures during system development and maintenance. Public utility

tax revenues may change. These taxes are a subcategory of selective sales taxes that includes taxes on providers of land and mobile telephone, telegraph, cable, and internet services (U.S. Census Bureau, 2006). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. In such cases, public utility tax revenues may increase, but they could also remain the same or decrease if providers are granted tax breaks in return for operating portions of the network. Individual and corporate income taxes may change as FirstNet infrastructure development and operation creates new taxable income for involved companies and workers.

FirstNet's partner(s) may be given the right to use excess NPSBN capacity commercially. This would result in additional economic activity and generation of income. In turn, this could have revenue implications for federal and state governments, through taxes on sales and on corporate income generated by commercial use of the network.

FirstNet may have an additional, non-revenue benefit to the public sector. The network is likely to create operational cost savings and increased productivity for public safety personnel.

Impacts to Employment

Private companies and government organizations that receive income from deploying and operating the NPSBN would use portions of that income to hire the employees they need to provide their support to the network. This generation of new employment could be a minor, direct, beneficial impact of expenditures on FirstNet. Additional, indirect employment increases would occur as additional businesses hire workers to provide supporting goods and services. For instance, FirstNet partner(s) and their subcontractors and vendors would need engineers and information technology professionals, project managers, construction workers, manufacturing workers, maintenance workers, and other technical and administrative staff. Further employment gains would occur as businesses throughout the economy benefit from consumer spending by wage earners in direct and indirectly affected businesses.

For the most part, employment gains in any particular state or community would generally be measurable, but small relative to the overall state or community economy. This is because FirstNet infrastructure investments would be dispersed across the nation. Based on the significance criteria above, the employment impacts would be considered positive and less than significant. However, even small employment gains are beneficial, and would be especially welcomed in areas that have high unemployment. As discussed in Affected Environment, unemployment rates (as shown by the unemployment rate map and selected economic indicators table) vary across Oregon. The average unemployment rate in 2014 was 6.9 percent, somewhat higher than the nation's unemployment rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were found around the Oregon portion of the Portland area and the Corvallis area. The remainder of the state had unemployment levels above the national average. The highest unemployment rates were generally in the counties located in the southern portion of the state.

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system

designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 7.2.9-1 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.

7.2.9.4. 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 7.2.9-1. 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 indicates which of the four types of socioeconomic impacts discussed above and listed again here apply to each type of deployment activity. For greater detail on the nature of these impacts, see the Description of Environmental Concerns section above.

- Impacts to Real Estate;
- Changes to Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

Positive impacts on property values would generally not result from one or a few particular activities, but instead would result from the totality of the new NPSBN infrastructure and operational systems that enable improved public safety services to currently underserved areas. Similarly, any change to population numbers in a few locations as discussed above would result from large contract awards and contractor decisions about employee locations, not from specific deployment activities. Therefore, these types of impacts are not included in the activity-focused discussions below.

- Wired Projects
 - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
 - Collocation on Existing Aerial Fiber Optic Plant: Collocation of new aerial fiber optic plant on existing utility poles and other structures would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
 - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus, the impacts would be less than significant.
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
 - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
 - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

- Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
 - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., 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, 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 partner(s) 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 Oregon. 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.

7.2.9.5. 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant at the programmatic level.

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) or other aspects (e.g., noise 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 Oregon. 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 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 7.1.9, Socioeconomics.

7.2.10. Environmental Justice

7.2.10.1. Introduction

This section describes potential impacts to environmental justice in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 7.2.10-1. As described in Section 7.2, 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 7.2.10-1: 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

7.2.10.3. *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 American 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. American Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* “adverse” and “disproportionately high” in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 7.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 7.1.10.4,

Figure 7.1.10-1) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 7.1.10.3, Oregon's population has low percentages of all minority groups. Oregon's poverty rate is similar to that of the West region and somewhat higher than the nation's rate. Oregon has many areas with high potential for environmental justice populations. The distribution of these high potential areas is fairly even across the state, and occurs both within and outside of the 10 largest population concentrations. This includes some of the state's most sparsely populated areas. 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 7.1.10.4, Environmental Justice Screening Results, may be useful. In addition, USEPA's EJSCREEN tool and USEPA's lists of environmental justice grant and cooperative agreement recipients may help identify local environmental justice populations (USEPA, 2015e; USEPA, 2016d).

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.

7.2.10.4. 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 ground disturbance, impacts to environmental justice communities would not occur. Impacts associated with satellite-enabled devices requiring construction activities are addressed below.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact environmental justice, 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 or the banks of waterbodies that 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise 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.

7.2.10.5. 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 7.1.10, Environmental Justice.

7.2.11. Cultural Resources

7.2.11.1. Introduction

This section describes potential impacts to cultural resources in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.11.2. 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 7.2.11-1. As described in Section 7.2, 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 7.2.11-1: 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 American Indian tribes and native Hawaiian organizations, to develop appropriate mitigation.

^b Per NHPA, a “historic property” is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project’s APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to American Indian tribes and other consulting parties that, in consultation with the respective party(ies), may or may not be eligible for listing in the NRHP. These sites may also be considered TCPs. Therefore, by definition, these significance criteria only apply to cultural resources that are historic properties, significant sites of religious and/or cultural significance, or TCPs. For the purposes of brevity, the term historic property is used here to refer to either historic properties, significant sites of religious and/or cultural significance, or TCPs.

NA = Not Applicable

7.2.11.3. 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 7.2.11-1, 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 Oregon, 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 alters historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs (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 Native Americans. 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.

7.2.11.4. 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 new perceptible 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 POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - **New Build – Aerial Fiber Optic Plant:** Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
 - **New Build – Submarine Fiber Optic Plant:** The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as coastal areas of Oregon where sea level was lower during glacial periods (generally the Middle Archaic Period and earlier) have the potential to contain archaeological sites. Impacts to cultural resources could also potentially occur as a result of the construction of landings and/or facilities on shores or banks of waterbodies that accept submarine cable, which could result in the disturbance of archaeological sites (archaeological deposits are frequently associated with bodies of water, and Oregon has numerous maritime archaeological sites associated with its 19th century history), and the associated structures could have visual effects on historic properties.
 - **Installation of Optical Transmission or Centralized Transmission Equipment:** If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads, there could potentially be impacts to cultural resources. Ground disturbance could impact archaeological sites and the associated structures could have visual effects on historic properties.
 - **Collocation on Existing Aerial Fiber Optic Plant:** Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-

term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.

- **Wireless Projects**
 - **New Wireless Communication Towers:** Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.
 - **Collocation on Existing Wireless Tower, Structure, or Building:** Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in the disturbance of archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas (such as Oregon City) that have larger numbers of historic public buildings.
 - **Deployable Technologies:** Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These activities could affect, but not adversely affect, cultural resources as the potential adverse effects would be temporary and limited to the area near individual Proposed Action deployment site. Additionally, some equipment proposed to be installed on or near properties that are listed or eligible for listing on the NRHP could potentially be removed. Additionally as appropriate, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 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.

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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.11.5. 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 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 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 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 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 7.1.11, Cultural Resources.

7.2.12. Air Quality

7.2.12.1. Introduction

This section describes potential impacts to Oregon'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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Oregon's air quality were evaluated using the significance criteria presented in Table 7.2.12-1. As described in Section 7.2, 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 Oregon's air quality addressed in this section are presented as a range of possible impacts.

Table 7.2.12-1: Impact Significance Rating Criteria for Air Quality

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Increased air emissions	Magnitude or Intensity	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are <i>de minimis</i> 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

7.2.12.3. 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 unknown 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 throughout Oregon that are in maintenance or nonattainment for one or more criteria pollutants—especially PM_{2.5} (Oregon DEQ - Air Quality Planning, 2015) (LRAPA, 2015) (see Section 7.1.12, Air Quality, Figure 7.1.12-1).

Based on the significance criteria presented in Table 7.2.12-1, air emission impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of emission sources be deployed/operated long-term in the same area from fixed or mobile sources or construction activities. Less than significant emissions could occur for any of the criteria pollutants within attainment areas in Oregon; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Oregon (Figure 7.1.12-1), 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.

7.2.12.4. 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 development 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 development scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- **Wired Projects**
 - **New Build – Buried Fiber Optic Plant:** Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and

- landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
- New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.
 - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
 - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate products of combustion from vessels used to lay the cable. In addition, the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable could result in products of combustion and fugitive dust from heavy equipment used for grading, foundation excavation, or other ground disturbing activities.
 - Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.
- Wireless Projects
 - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducting excavation activities, and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
 - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. If the delivery of additional power units, structural hardening, and physical security measures required grading or excavation, then exhaust and fugitive dust from heavy equipment used for these activities could also result in increased air emissions.
 - Deployable Technologies: The type of deployable technology used would dictate the types of air pollutants generated. For example, mobile equipment deployed via heavy trucks could generate products of combustion from the internal combustion engines associated with the vehicles and onboard generators. These units may also generate

fugitive dust depending on the type of road traveled during deployment (i.e., paved versus unpaved roads). Aerial platforms (e.g., UASs or other aircraft) would generate pollutants during all phases of flight.

In general, the pollutants of concern from the abovementioned activities would be products of combustion from burning fossil fuels in internal combustion engines and fugitive dust from site preparation activities and vehicles traveling on unpaved road surfaces. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are anticipated to be less than significant 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.12.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

7.2.13.Noise

7.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Oregon. 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.

7.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 7.2.13-1. As described in Section 7.2, 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 Oregon addressed in this section are presented as a range of possible impacts.

Table 7.2.13-1: 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.

7.2.13.3. 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 7.1.13, Noise).

Based on the significance criteria presented in Table 7.2.13-1, 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.

7.2.13.4. 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 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 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 noise from 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, POPs, huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in temporary increases in noise levels from the use of heavy equipment and machinery.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Installation of new associated huts or equipment, if required, could result in short-term and temporarily higher noise levels if the activity required the use of heavy equipment for grading or other purposes.
- New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could generate noise if vessels are utilized 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. 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.13.5. 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 Alternative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment.

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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts could be minimal in those areas. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that potential noise 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or

satellites and other technologies. Noise would therefore be the same as described in Section 7.2.13, Noise.

7.2.14. Climate Change

7.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.14.2. 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 7.2.14-1. As described in Section 7.2, 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 CO₂e 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 CO₂e in 2013 (USEPA, 2015o), the sum of additional emissions as a consequence of the deployment of FirstNet, combined with multiple new sources of CO₂ 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 7.2.14-1: Impact Significance Rating Criteria for Climate Change

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less Than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO ₂ e/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

7.2.14.3. Projected Future Climate

Climate model forecasts of future temperatures are highly dependent on emissions scenarios (low versus high), particularly in projections beyond 2050. An increase in average annual temperature of 3.3 °F to 9.7 °F is projected by 2070 to 2099 (compared to the period 1970 to 1999), depending largely on a low or high emissions scenario. The increases are projected to be largest in summer. (USGCRP, 2014a)

Additionally, the Northwest is projected to observe a longer frost-free season by mid-century as compared to a 1971 – 2000 baseline, where a frost-free season is defined as the period between the last occurrence of 32 °F in the spring and the first occurrence of 32 °F in the fall. In Oregon, the frost-free season under a high emissions scenario is expected to extend greater than 70 days longer than the baseline years in much of the state. (USGCRP, 2014e)

Air Temperature

Figures 7.2.14-1 and 7.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Oregon from a 1969 to 1971 baseline.

Bsk – Figure 7.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the Bsk region of Oregon under a low emissions scenario would increase by approximately 4 °F. By the end of the century (2080 to 2099) under a low emissions scenario temperatures in the Bsk region would increase by approximately 5 or 6 °F depending on the portion of the region. (NOAA, 2015i)

Figure 7.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 4 or 5 °F depending on the portion of the region. Under a high emissions scenario for the period (2080 to 2099) in the Bsk region of Oregon, temperatures would increase by approximately 8 or 9 °F depending on the portion of the region. (NOAA, 2015i)

Cfa – Temperatures in this region are expected to increase by mid-century (2040 to 2059) under a low emissions scenario at the same rate as the Bsk region. By the end of the century (2080 to 2099) under a low emissions scenario temperatures are expected to increase 5 °F. (NOAA, 2015i)

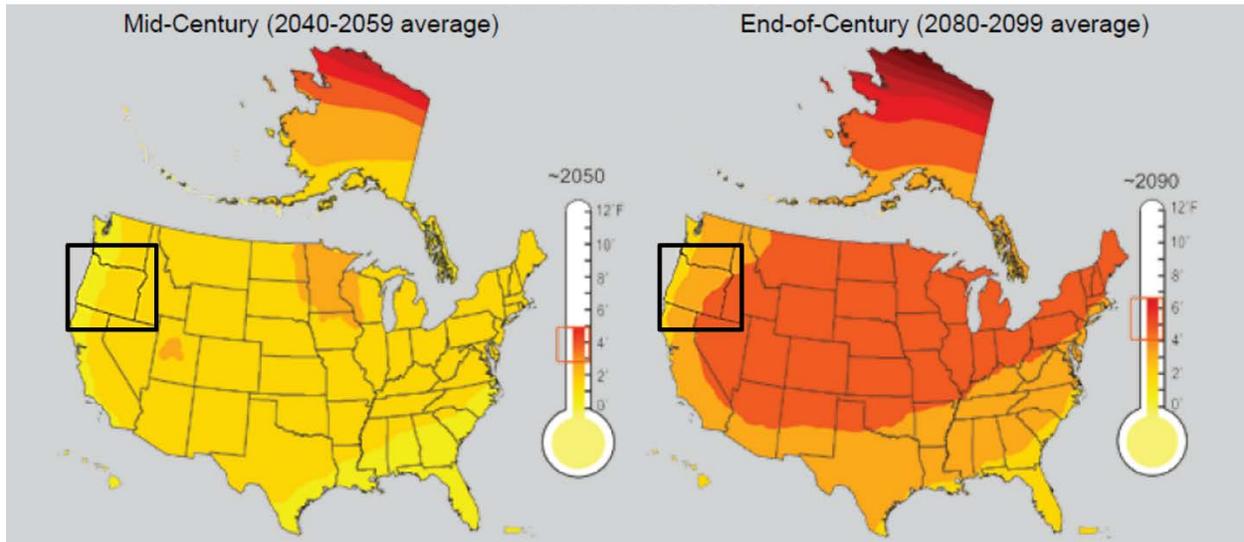
Under a high emissions scenario by mid-century temperatures are projected to increase 5 °F, and by the end of the century by 8 °F in the Cfa region of Oregon. (NOAA, 2015i)

Csb – Temperatures in this region are expected to increase 3 °F on the west coast and 4 °F in the remainder of the region by mid-century (2040 to 2059). By the end of the century, temperatures are expected to increase 4, 5, or 6 °F depending on the portion of the region. (NOAA, 2015i)

Under a high emissions scenario temperatures would increase by 3, 4, or 5 °F depending on the portion of the region. By the end of the century (2080 to 2099), under a high emissions scenario, temperatures in the Csb region would increase by approximately 6 °F on a small portion of the coast, and by 7, 8, or 9 moving west to east respectively. (NOAA, 2015i)

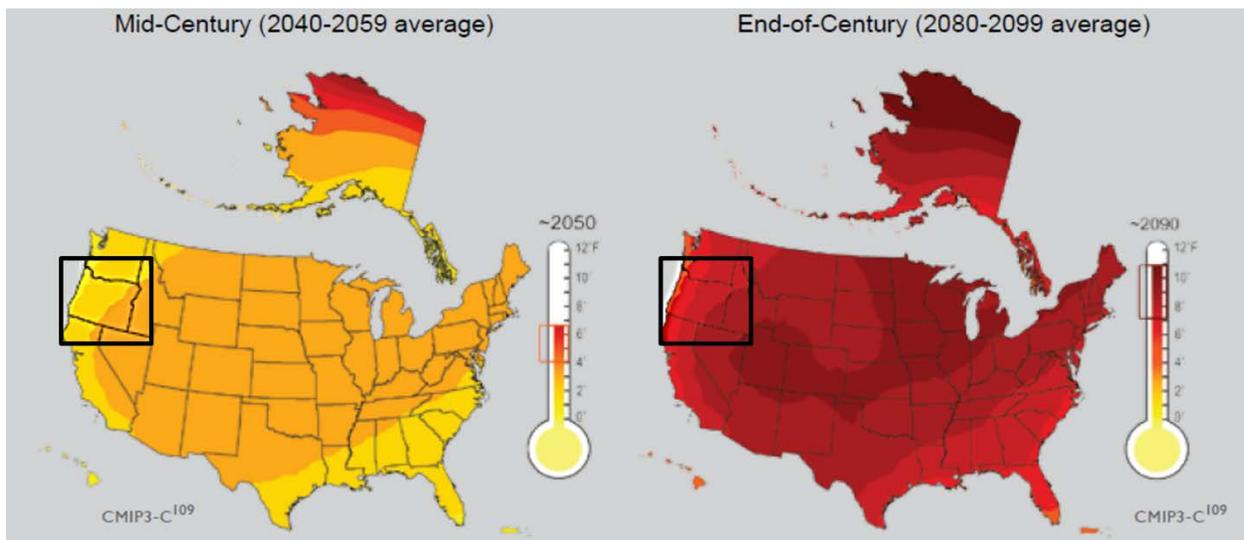
Dsb – Temperatures in the Dsb region of Oregon under a low emissions scenario are expected to increase by mid-century and by the end of the century at the same rate as the Cfa region. (NOAA, 2015i)

Under a high emissions scenario temperatures in the Dsb region are projected to increase by 4 °F by mid-century, and increase approximately 8 °F by the end of the century. (NOAA, 2015i)



Source: (NOAA, 2015i)

Figure 7.2.14-1: Oregon Low Emission Scenario Projected Temperature Change



Source: (NOAA, 2015i)

Figure 7.2.14-2: Oregon High Emission Scenario Projected Temperature Change

Precipitation

Under a high emissions scenario, summer precipitation is projected to decrease by as much as 30 percent by the end of the century in the Northwest (USGCRP, 2014a). “Northwest summers are already dry and although a 10 percent reduction (the average projected change for summer) is a small amount of precipitation, unusually dry summers have many noticeable consequences, including low streamflow west of the Cascades and greater extent of wildfires throughout the region” (USGCRP, 2014a).

In Oregon, there is an expected increase of about 10 percent in the number of consecutive dry days under a low emissions scenario by mid-century (2041 to 2070) as compared to the period (1971 – 2000). Under a high emissions scenario in the majority of the state there is a projected increase of about 20 percent in the number of consecutive dry days and an increase of 30 percent in the northwestern portion of the state. An increase in consecutive dry days could lead to drought. (USGCRP, 2014b)

Figures 7.2.14-3 and 7.2.14-4 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 7.2.14-3 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 7.2.14-4 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 7.2.14-3 shows that in a low emissions reduction scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter and spring in the Bsk region of Oregon. However, there are no expected changes in precipitation in summer or fall other than fluctuations due to natural variability. (USGCRP, 2014b)

Figure 7.2.14-4 shows that if emissions continue to increase, winter precipitation is expected to increase 20 percent in the majority of the region with a 30 percent increase in the southeastern corner. In spring and fall, precipitation in this scenario could increase as much as 10 percent in some portions of the region while precipitation in other portions is expected to remain constant. Summer precipitation is expected to decrease 10 percent. (USGCRP, 2014b)

Cfa – Precipitation changes for the Cfa region are consistent with projected changes for the Bsk region of Oregon under a low GHG emissions scenario. There are no expected changes in precipitation in summer or fall other than fluctuations due to natural variability. (USGCRP, 2014b)

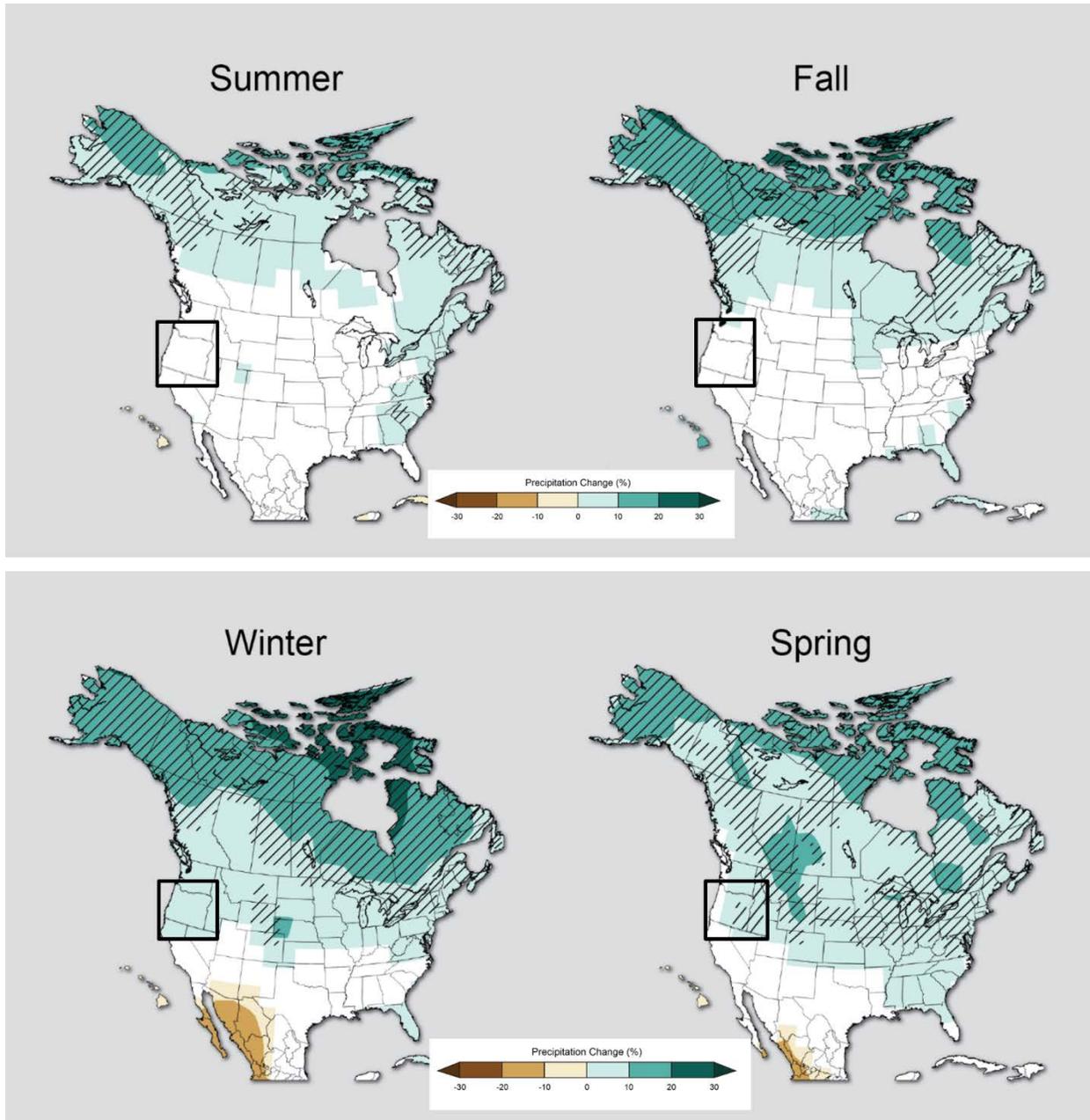
Under a high emissions scenario precipitation is expected to increase 20 percent in winter. In spring and fall, precipitation is expected to increase 10 percent. Summer precipitation is anticipated to decrease 20 percent. (USGCRP, 2014b)

Csb – Under a low emissions scenario, winter precipitation is expected to increase 10 percent. Spring precipitation is expected to increase 10 percent in the majority of the region, however is expected to remain constant along the coast. There are no expected changes to summer or fall precipitation. (USGCRP, 2014b)

Precipitation for the Csb region under a high emissions scenario is expected to increase 20 percent in winter. In spring and fall, precipitation is expected to increase 10 percent or remain constant depending on the portion of the region. Summer precipitation is expected to decrease 10, 20, or 30 percent depending on the portion of the region. (USGCRP, 2014b)

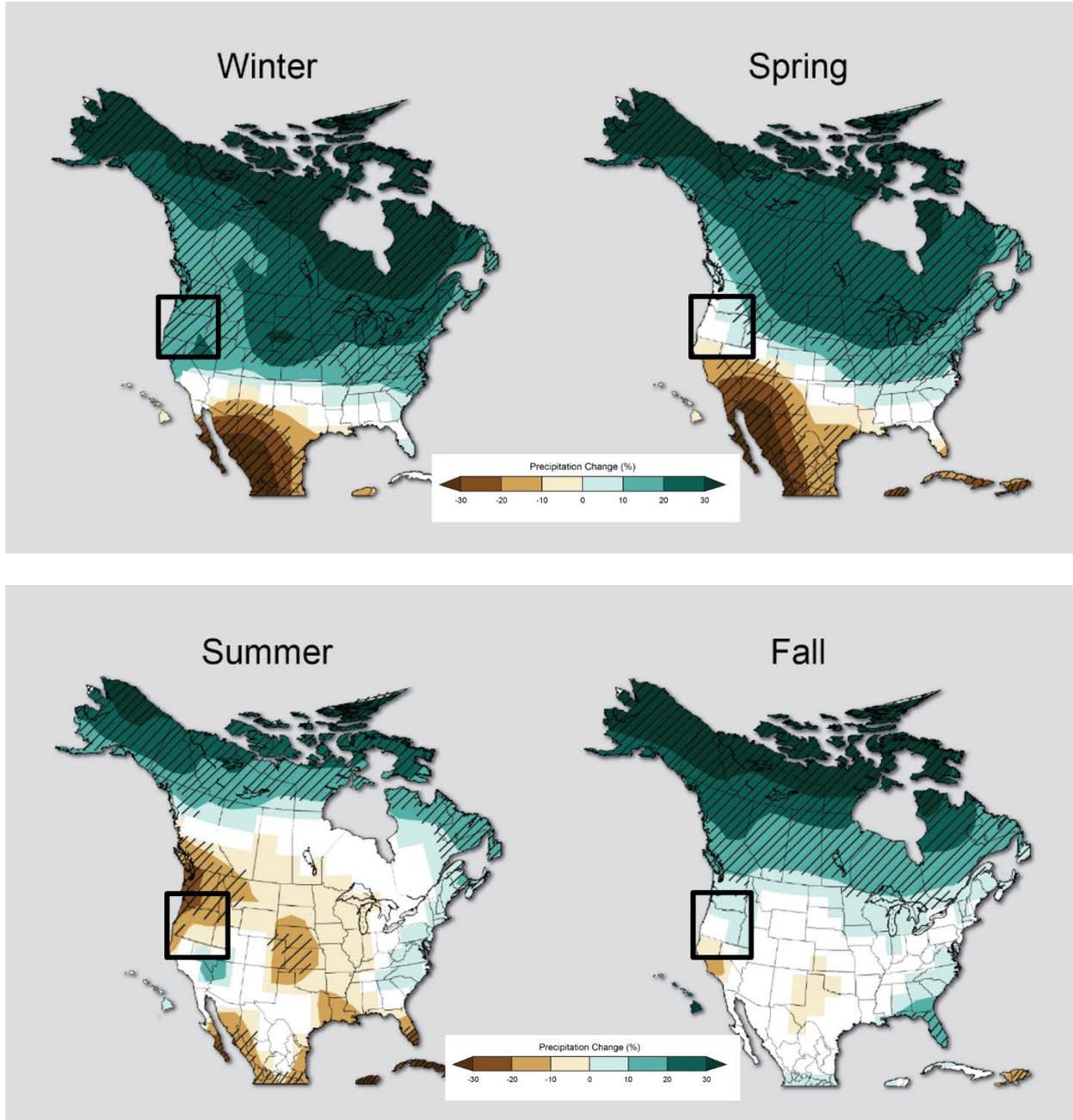
Dsb – Precipitation for the Dsb region are consistent with projected changes for the Bsk and Cfa regions of Oregon under a low emissions scenario. (USGCRP, 2014b)

Under a high emissions scenario in the Dsb region, precipitation is expected to increase 20 percent in winter and decrease 20 percent in winter. There are no anticipated changes to spring precipitation. Fall precipitation is expected to increase 10 percent. (USGCRP, 2014b)



Source: (USGCRP, 2014b)

Figure 7.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario



Source: (USGCRP, 2014b)

Figure 7.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

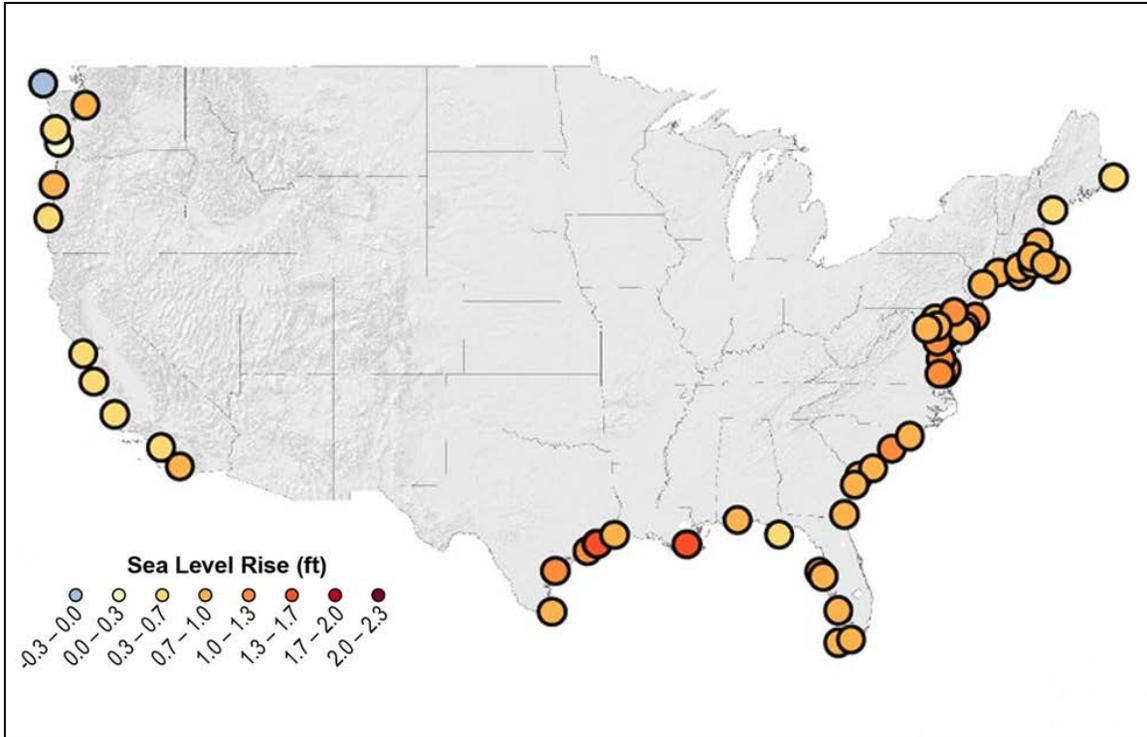
Sea Level

Several factors would continue to affect sea level rise in the future. Glacier melt adds water to the ocean, and increasing ocean temperatures result in thermal expansion. Worldwide, “glaciers have generally shrunk since the 1960s, and the rate at which glaciers are melting has accelerated over the last decade. The loss of ice from glaciers has contributed to the observed rise in sea level” (USEPA, 2012c). When water warms, it also expands, which contributes to sea level rise in the world’s oceans. “Several studies have shown that the amount of heat stored in the ocean has increased substantially since the 1950s” (USEPA, 2012c). Sea level and currents could be influenced by the amount of heat stored in the ocean. (USEPA, 2012c)

The amount of sea level rise would vary in the future along different stretches of the U.S. coastline and under different absolute global sea level rise scenarios. Variation in sea level rise along different stretches of coast is mostly due to varying rates of land subsidence (also known as relative sea level rise). In the National Climate Assessment (NCA) potential sea level rise scenarios were reported. These scenarios were developed based on varying degrees of ocean warming and ice sheet loss as estimated by organizations like IPCC (NOAA, USGS, SERPD, and USACE, 2012). Figures 7.2.14-5 and 7.2.14-6 show feet of sea level above 1992 levels at different tide gauge stations. Figure 7.2.14-5 shows an 8 inch global sea level rise above 1992 levels by 2050 and Figure 7.2.14-6 shows a 1.24 foot global sea level rise above 1992 levels by 2050 (USGCRP, 2014c).

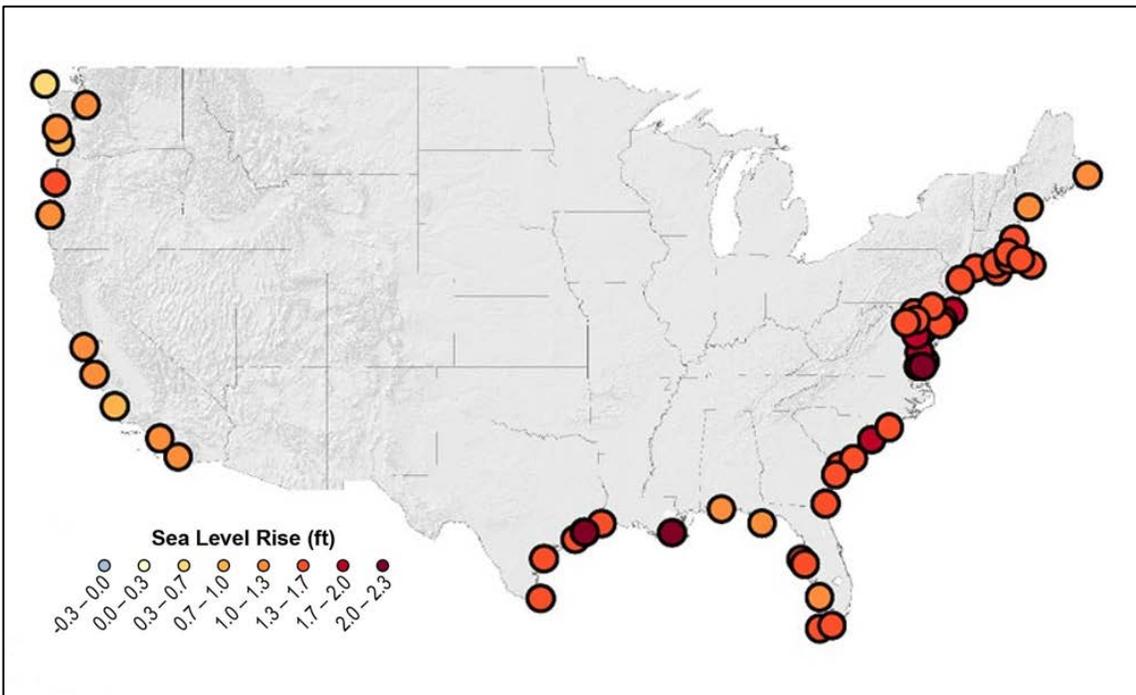
Csb – Figure 7.2.14-5 presents an 8-inch global average sea level rise above 1992 levels, resulting in a 0.7 to 1.3 foot sea level rise in 2050 along the coast of Oregon. Figure 7.2.14-6 indicates that a 1.24-foot sea level rise above 1992 level would result in a 1.0 to 1.7 foot sea level rise in 2050 along the coast of Oregon. (USGCRP, 2014c)

Bsk, Cfa and Dsb – These regions are not affected by sea level rise.



Source: (USGCRP, 2014c)

Figure 7.2.14-5: 8-inch Sea Level Rise Above 1992 Levels by 2050



Source: (USGCRP, 2014c)

Figure 7.2.14-6: 1.24-foot Sea Level Rise Above 1992 Levels by 2050

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as 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, 2014d)

7.2.14.4. Description of Environmental Concerns

Greenhouse Gas Emissions

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts, and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO₂ emissions from fossil fuels.

Based on the impact significance criteria presented in Table 7.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or onsite electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO₂ 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 CO₂ per gallon (EIA, 2015i). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO₂/day. Running continuously, the tower would cause the emission of 446 MT of CO₂ per year.

However, grid-provided electricity would result in less CO₂ emissions than onsite provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs./MWh (USEPA, 2015p), the same transmitter would be responsible for approximately 271 MT of CO₂

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.

Climate change may expose areas of Oregon to longer and more intense heat waves which may have negative impacts on human morbidity and mortality (USFS, 2015j), although no significant trends have been observed yet with the exception of increases in nighttime temperatures starting in 1980 (Oregon Health Authority, 2014). The increased severity and length of droughts is expected to increase in Oregon as snow pack is reduced and temperatures rise. This in turn may contribute to more frequent and larger wildland fires as well as increased fuel load in the form of dead trees caused by invasive bark beetles that thrive in stressed forest environments. Together these may have transformative effects on the composition and extent of forest ecosystems (USFS, 2015j).

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 Oregon 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 (USFS, 2015j). Extended periods of extreme heat may increase general demand on the electric grid, impede normal grid operations, and overwhelm the capacity onsite equipment needed to keep microwave and other transmitters cool (DOE, 2015). Increased wildland fires under climate change warning scenarios may present a risk to both permanent and mobile installations as well as to first responders themselves.

Based on the impact significance criteria presented in Table 7.2.14-1, climate change effects on FirstNet installations and infrastructure would be significant if they negatively affected the operation of these facilities.

7.2.14.5. 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 Oregon, including deployment and operation activities.

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment and operation of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to GHG emissions, climate impacts in other resource areas, and FirstNet infrastructure and operations, and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to climate change under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- **Satellites and Other Technologies**
 - **Distribution of Satellite Enabled Devices and Equipment:** The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore, it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts

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 workboats 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 backup), 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 backup), and would depend on their size, number, and the frequency and duration of their use.

- Deployable Technologies
 - COWs, COLTs, or SOWs: The long-term operations of these mobile systems have the potential to have GHG emission impacts 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated 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.

7.2.14.6. 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operations Impacts

Implementing land-based deployable technologies (COW, COLT, and SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have 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 the operation of deployables. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant due to 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, 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 7.1.14, Climate Change.

7.2.15. Human Health and Safety

7.2.15.1. Introduction

This section describes potential impacts to human health and safety in Oregon 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.15.2. 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 7.2.15-1. As described in Section 7.2, 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 7.2.15-1: 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

7.2.15.3. 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 7.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical or chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

To protect occupational workers, 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,¹⁵⁶ 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.

¹⁵⁶ Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016b)

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 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 (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure.

The Oregon Occupational Safety and Health Division (Oregon OSHA) is authorized by OSHA to administer the state program that oversees employee safety in all state and local government and private sector 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 7.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties or abandoned mine lands. Prior to the start of

any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and DOI's Abandoned Mine Lands Inventory, through the ODEQ, or through an equivalent commercial resource.

By screening sites for environmental contamination, mining activities, and reported environmental liabilities, the presence of historic contamination and unsafe ground conditions could be evaluated and may influence the site selection process. In general, the lower the density of environmental contamination or mining activities, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination (or mine lands) are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is observed to be stained or emitting an unnatural odor, it may be an indication of environmental contamination. When such instances are encountered, it may be necessary to stop work until the anomaly is further assessed through record reviews or environmental sampling. Proposed FirstNet deployment would attempt to avoid known contaminated sites. However, in the event that FirstNet is unable to avoid a contaminated site, then site analysis and remediation would be required under RCRA, CERCLA, and applicable Oregon state laws in order to protect workers and the public from direct exposure or fugitive contamination.

Exposure assessments identify relevant site characteristics, temporal exposure parameters, and toxicity data to determine the likelihood of adverse health effects. More formally known as a human health risk assessment (HHRA), these studies provide mathematical justification for implementing controls at the site to protect human health. If the HHRA determines the potential for adverse health effects is too great OHA-PHD 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 7.2.15-1, 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.

7.2.15.4. 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 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 human health and safety under the conditions described below:

- **Wired Projects**
 - **Use of Existing Conduit – New Buried Fiber Optic Plant:** the pulling or blowing of fiber optic cable would be performed through existing conduit. Use of mechanical equipment would be limited to pulley systems and blowers. Some locations with no existing power supply may require the use of electrical generators. Hazardous materials needed for this work would include fiber optical cable lubricants, mechanical oil/grease, and fuel for electrical generators although these materials are expected to be used infrequently and in small quantities. These activities are not likely to result in serious injury or chemical exposure, or surface disturbances since work would be limited to existing entry and exit points, would be temporary, and intermittent. It is anticipated that there would be no impacts to human health and safety.
 - **Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable:** Lighting up of dark fiber would have no impacts on human health and safety because there would be no ground disturbance or heavy equipment used.
- **Satellites and Other Technologies**
 - **Deployment of Satellites:** FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact human health and safety resources, it is anticipated that this activity would have no impact 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 could require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or

releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of fiber optic cables in limited nearshore and inland bodies of water requires workers to operate over aquatic and/or marine environments, which presents opportunities for drowning. When working over water, exposure to sun, high or low temperatures, wind, and moisture could impact worker safety. Construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cable would require site preparation, construction, and management of hazardous materials and hazardous waste. Excavation of soils or sediments at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would require site preparation, construction activities, and

management of hazardous materials and hazardous waste. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Wireless Projects
 - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads would require site preparation, construction activities, and management of hazardous materials and hazardous waste. Communication towers would be erected, requiring workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
 - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling 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, environmental contamination, and mine lands), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment were part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental

hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be less than significant 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

7.2.15.5. 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 were an electrical generator, then there would 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 partner(s) would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative. Use of PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment were part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be less than significant because of the small-scale of likely FirstNet activities; activities associated with routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 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 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 7.1.15, Human Health and Safety.

OR APPENDIX A – WATER RESOURCES

Table A-1: Oregon Federal Wild, Scenic, and Recreational Rivers

River Name	River Description	Designation
Big Marsh Creek	October 28, 1988. From NE 1/4 Section 15, T26S, R6E to the confluence with Crescent Creek.	Recreational — 15.0 miles
Chetco River	October 28, 1988. From its headwaters to the Rogue River-Siskiyou National Forest boundary.	Wild — 27.5 miles; Scenic — 8.0 miles; Recreational — 11.0 miles
Clackamas River	October 28, 1988. From Big Springs to Big Cliff.	Scenic — 20.0 miles; Recreational — 27.0 miles
Clackamas River (South Fork)	March 30, 2009. From its confluence with the East Fork of the South Fork Clackamas to its confluence with the Clackamas River.	Wild — 4.2 miles
Collawash River	March 30, 2009. From the headwaters of the East Fork of the Collawash River to Buckeye Creek.	Scenic — 11 miles; Recreational — 6.8 miles
Crescent Creek	October 28, 1988. From SW 1/4 of Section 11, T24S, R6E to the west section line of Section 13, T24S, and R7E.	Recreational — 10.0 miles
Crooked River	October 28, 1988. From the National Grassland boundary to Dry Creek.	Recreational — 17.8 miles
Crooked River (North Fork)	October 28, 1988. From its source at Williams Prairie to one mile from its confluence with the Crooked River.	Wild — 12.2 miles; Scenic — 8.2 miles; Recreational — 13.3 mile
Deschutes River	October 28, 1988. From Wikiup Dam to the Bend Urban Growth boundary at the southwest corner of Section 13, T18S, R11E. From Odin Falls to the upper end of Lake Billy Chinook. From the Pelton Reregulating Dam to the confluence with the Columbia River.	Scenic — 31.0 miles; Recreational — 143.4 miles
Donner und Blitzen River	October 28, 1988, and October 30, 2000. October 28, 1988: From its headwaters to the confluence with the South Fork Blitzen and Little Blitzen, including the tributaries: Little Blitzen River, South Fork Blitzen River, Big Indian Creek, Little Indian Creek, and Fish Creek. October 30, 2000: Mud Creek from its source to its confluence with the Donner und Blitzen River; Ankle Creek from its headwaters to its confluence with the Donner und Blitzen River; and the South Fork of Ankle Creek from its source to its confluence with Ankle Creek.	Wild — 87.5 miles
Eagle Creek (Mt. Hood National Forest)	March 30, 2009. From its headwaters to the Mt. Hood National Forest boundary.	Wild — 8.3 miles
Eagle Creek (Wallowa-Whitman National Forest)	October 28, 1988. From its headwaters below Eagle Lake to the Wallowa-Whitman National Forest boundary at Skull Creek.	Wild — 4.5 miles; Scenic — 6.0 miles; Recreational — 18.4 miles

River Name	River Description	Designation
Elk River	October 28, 1988, and March 30, 2009. The main stem from the confluence of the North and South Forks of the Elk River to Anvil Creek. The North Fork from its source in Section 21, Township 33 South, Range 12 West, to its confluence with the South Fork. The South Fork Elk from its source in the southeast quarter of Section 32, Township 33 South, Range 12 West, to its confluence with the North Fork.	Wild — 9.7 miles; Scenic — 1.5 miles; Recreational — 17.0 miles;
Elkhorn Creek	September 30, 1996. This wild and scenic river consists of a 5.8-mile wild river area, extending from a point along the Willamette National Forest to its confluence with Buck Creek. A smaller segment of 0.6 miles, designated as a scenic river area, extends from the confluence of Buck Creek to that point where the segment leaves the BLM boundary in Township 9.	Wild — 5.8 miles; Scenic — 0.6 miles
Fifteenmile Creek	March 30, 2009. From its source at Senecal Spring to the southern edge of the northwest quarter of the northwest quarter of Section 20, Township 2 South, Range 12 East.	Wild — 10.5 miles; Scenic — 0.6 miles
Fish Creek	March 30, 2009. From its headwaters to its confluence with the Clackamas River.	Recreational — 13.5 miles
Grande Ronde River	October 28, 1988. From its confluence with the Wallowa River to the Oregon-Washington border.	Wild — 26.4 miles; Recreational — 17.4 miles
Hood River (East Fork)	March 30, 2009. From Oregon State Highway 35 to the Mt. Hood National Forest boundary.	Recreational — 13.5 miles
Hood River (Middle Fork)	March 30, 2009. From the confluence of Clear and Coe Branches to the north section line of Section 11, Township 1 South, Range 9 East.	Scenic — 3.7 miles
Illinois River	October 19, 1984. From the boundary of the Siskiyou National Forest downstream to its confluence with the Rogue River.	Wild — 28.7 miles; Scenic — 17.9 miles; Recreational — 3.8 miles
Imnaha River	October 28, 1988. The main stem from the confluence of the North and South Forks of the Imnaha River to its mouth. The South Fork from its headwaters to the confluence with the main stem.	Wild — 15.0 miles; Scenic — 4.0 miles; Recreational — 58.0 miles
John Day River	October 28, 1988. From Service Creek to Tumwater Falls.	Recreational — 147.5 miles
John Day River (North Fork)	October 28, 1988. From its headwaters in the North Fork of the John Day Wilderness Area to its confluence with Camas Creek.	Wild — 27.8 miles; Scenic — 10.5 miles; Recreational — 15.8 mile
John Day River (South Fork)	October 28, 1988. From the Malheur National Forest boundary to the confluence with Smoky Creek.	Recreational — 47.0 miles
Joseph Creek	October 28, 1988. From Joseph Creek Ranch, one mile downstream from Cougar Creek, to the Wallowa-Whitman National Forest boundary.	Wild — 8.6 miles
Klamath River	September 22, 1994. From the J.C. Boyle Powerhouse to the California-Oregon border. The Klamath River is in Klamath County 25 miles to the southwest of Klamath Falls in south-central Oregon.	Scenic — 11.0 miles
Little Deschutes River	October 28, 1988. From its source in the northwest 1/4 of Section 15, T26S, R6E, to the north section line of Section 12, T26S, and R7E.	Recreational — 12.0 miles

River Name	River Description	Designation
Lostine River	October 28, 1988. From its headwaters in the Eagle Cap Wilderness to the Wallowa-Whitman National Forest boundary.	Wild — 5.0 miles; Recreational — 11.0 miles
Malheur River	October 28, 1988. From Bosenberg Creek to the Malheur National Forest boundary.	Wild — 6.7 miles; Scenic — 7.0 miles
Malheur River (North Fork)	October 28, 1988. From its headwaters to the Malheur National Forest boundary.	Scenic — 25.5 miles
McKenzie River	October 28, 1988. From Clear Creek to Scott Creek, not including Carmen and Trail Bridge Reservoir Dams.	Recreational — 12.7 miles
Metolius River	October 28, 1988. From the Deschutes National Forest boundary to Lake Billy Chinook.	Scenic — 17.1 miles; Recreational — 11.5 miles
Minam River	October 28, 1988. From its headwaters at the south end of Minam Lake to the Eagle Cap Wilderness boundary, one-half mile downstream from Cougar Creek.	Wild — 41.9 miles
North Powder River	October 28, 1988. From its headwaters in the Elkhorn Mountains to the Wallowa-Whitman National Forest boundary.	Scenic — 6.4 miles
North Umpqua River	October 28, 1988. From Soda Springs Powerhouse to the confluence with Rock Creek.	Recreational — 33.8 miles
Owyhee River	October 19, 1984. From Three Forks downstream to China Gulch. Crooked Creek to the Owyhee Reservoir. The South Fork from the Idaho-Oregon border downstream to Three Forks.	Wild — 120.0 miles
Owyhee River (North Fork)	October 28, 1988. From the Oregon-Idaho state line to its confluence with the Owyhee River.	Wild — 9.6 miles
Powder River	October 28, 1988. From Thief Valley Dam to the Highway 203 Bridge.	Scenic — 11.7 miles
Quartzville Creek	October 28, 1988. From the Willamette National Forest boundary to the slack water of Green Peter Reservoir.	Recreational — 12.0 miles
River Styx	December 19, 2014. The subterranean segment of Cave Creek flowing within Oregon Caves National Monument.	Scenic — 0.4 miles
Roaring River	October 28, 1988. From its headwaters to the confluence with the Clackamas River.	Wild — 13.5 miles; Recreational — 0.2 miles
Roaring River (South Fork)	March 30, 2009. From its headwaters to its confluence with Roaring River.	Wild — 4.6 miles
Rogue River	October 2, 1968. The segment of the river extending from the mouth of the Applegate River downstream to the Lobster Creek Bridge.	Wild — 33.6 miles; Scenic — 7.5 miles; Recreational — 43.4 miles
Rogue River (Upper)	October 28, 1988. From the Crater Lake National Park boundary downstream to the Rogue River National Forest boundary at Prospect.	Wild — 6.1 miles; Scenic — 34.2 miles
Salmon River	October 28, 1988. From its headwaters to its confluence with the Sandy River.	Wild — 15.0 miles; Scenic — 4.8 miles; Recreational — 13.7 miles
Sandy River	October 28, 1988. From the headwaters to the Mt. Hood National Forest boundary. From the east boundary of Section 25 and 36, T1S, R4E downstream to the west line of the east 1/2 of northeast 1/4 Section 6, T1S, and R4E.	Wild — 4.5 miles; Scenic — 3.8 miles; Recreational — 16.6 miles
Smith River (North Fork)	October 28, 1988. From its headwaters to the Oregon-California state line.	Wild — 8.5 miles; Scenic — 4.5 miles

River Name	River Description	Designation
Snake River	December 1, 1975. The segment from Hells Canyon Dam downstream to an eastward extension of the north boundary of section 1, T5N, R47E, Willamette meridian.	Wild — 32.5 miles; Scenic — 34.4 miles
Sprague River	October 28, 1988. From the head of River Spring in the southwest 1/4 Section 15, T35S, R16E to the northwest 1/4 of southwest Section 11, T35S, R15E.	Scenic — 15.0 miles
Squaw Creek	On December 8, 2005, the U.S. Board on Geographic Names approved the name change of Squaw Creek and other public place names that used the term “squaw.” However, the Wild & Scenic Rivers Act has not yet been amended to reflect this name change. Making this change officially in the Wild and Scenic Rivers Act requires a technical correction, which is underway. Until then, we make note of the fact that legally the designation is for Squaw Creek, and we have a placeholder for that name, but we are proceeding under the name Whychus Creek and will delete all references to Squaw Creek when the amendment is completed. See Whychus Creek below.	Wild — 6.6 miles; Scenic — 8.8 miles
Sycan River	October 28, 1988. From the northeast 1/4 of Section 5, T34S, R17E to Coyote Bucket at the Fremont National Forest boundary.	Scenic — 50.4 miles; Recreational — 8.6 miles
Wallowa River	July 23, 1996. The segment of the Wallowa River from the confluence of the Wallowa and Minam Rivers in the hamlet of Minam downstream to the confluence of the Wallowa and the Grande Ronde Rivers.	Recreational — 10.0 miles
Wenaha River	October 28, 1988. From the confluence of the North and South Forks to its confluence with the Grande Ronde River.	Wild — 18.7 miles; Scenic — 2.7 miles; Recreational — 0.2 miles
West Little Owyhee River	October 28, 1988. From its headwaters to its confluence with the Owyhee River.	Wild — 57.6 miles
Whychus Creek	October 28, 1988. From its source to the gauging station 800 feet upstream from the intake of McAllister Ditch.	Wild — 6.6 miles; Scenic — 8.8 miles
White River	October 28, 1988. From Mt. Hood National Forest to the confluence with the Deschutes River.	Scenic — 24.3 miles; Recreational — 22.5 miles
Wildhorse & Kiger Creeks	October 30, 2000. Kiger Creek, from its headwaters at the top of Kiger Gorge to the boundary of the Steens Mountain Wilderness Area. Wildhorse Creek, from its headwaters to the private property line at the mouth of Wildhorse Canyon, into section 34, township 34 south, range 33 east. Little Wildhorse Creek from its headwaters to its confluence with Wildhorse Creek.	Kiger Creek, Wild — 4.3 miles; Wildhorse Creek, Wild — 7.0 miles; Little Wildhorse Creek, Wild — 2.6 miles
Willamette River (North Fork Middle Fork)	October 28, 1988. From Waldo Lake to the Willamette National Forest boundary.	Wild — 8.8 miles; Scenic — 6.5 miles; Recreational — 27.0 mile
Zigzag River	March 30, 2009. From its headwaters to the Mt. Hood Wilderness boundary.	Wild — 4.3 miles

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

OR APPENDIX B – BIOLOGICAL RESOURCES

Table B1: Essential Fish Habitat Freshwater Systems of Oregon

Common Name	Eggs	Larvae/YOY ¹⁵⁷	Juveniles	Adults
Chinook Salmon	Bottom habitats with gravel or cobble in those water identified in Alaska Department of Fish and Game (ADF&Gs) Catalogue of waters for the spawning, rearing, or migration of anadromous fishes	Bottom habitats with gravel or cobble in those water identified in ADF&Gs Catalogue of waters for the spawning, rearing, or migration of anadromous fishes	Bottom habitats with gravel or cobble in those water identified in ADF&Gs Catalogue of waters for the spawning, rearing, or migration of anadromous fishes. Juvenile out-migrate to the sea in April each year.	Spawning substrates consisting of gravels from April through September
Coho Salmon	Bottom habitats with gravel or cobble in those water identified in ADF&Gs Catalogue of waters for the spawning, rearing, or migration of anadromous fishes	Bottom habitats with gravel or cobble in those water identified in ADF&Gs Catalogue of waters for the spawning, rearing, or migration of anadromous fishes	Bottom habitats with gravel or cobble in those water identified in ADF&Gs Catalogue of waters for the spawning, rearing, or migration of anadromous fishes.	Spawning substrates consisting of gravels from April through September

Table B-2: Essential Fish Habitat Offshore of Oregon

Common Name	Eggs	Larvae/YOY	Juveniles	Adults
Albacore Tuna	None	None	Oceanic, epipelagic waters beyond the 100 fm isobaths.	Oceanic, epipelagic waters beyond the 100 fm isobaths.
Northern Bluefin Tuna	None	None	Oceanic, epipelagic waters beyond the 100 fm isobaths.	None
Chinook Salmon	None	None	Marine populations for this life state are found in estuarine areas and from the mean higher tide line to the 200 nm-limit	Marine populations for this life state are found in estuarine areas and from the mean higher tide line to the 200 nm-limit

¹⁵⁷ YOY (Young of the year): “All of the fish of a species that were born in the past year, from transformation to juvenile until January 1.” (USEPA 2015v)

Common Name	Eggs	Larvae/YOY	Juveniles	Adults
Chum Salmon	Spawn in the lower reaches of coastal streams less than 100 miles from the ocean.	Fry migrate to sea shortly after emergence	Stay in coastal waters from the Columbia south to Tillamook.	Migrate to streams for spawning.
Coho Salmon	None	None	Marine populations for this life state are found in estuarine areas and from the mean higher tide line to the 200 nm limit.	Marine populations for this life state are found in estuarine areas and from the mean higher tide line to the 200 nm-limit
Pelagic Species (northern anchovy, Pacific sardine, Pacific (chub) mackerel, and jack mackerel)	All marine and estuary waters to the limits of the 200 nm limit and above the thermocline where sea surface temperatures range between 10 degrees and 26 degrees Celsius			
Krill (<i>Euphausia pacifica</i> , <i>Thysanoessa spinifera</i> , and other krill species)	None	Shoreline to 500 fm isobaths (<i>E. pacifica</i>) to 1000 fm isobaths (all other krill); from the surface to 100 m deep (<i>E. pacifica</i>) to 400 m deep (all other krill)	Shoreline to 500 fm isobaths (<i>E. pacifica</i>) to 1000 fm isobaths (all other krill); from the surface to 100 m deep (<i>E. pacifica</i>) to 400 m deep (all other krill)	Shoreline to 500 fm isobaths (<i>E. pacifica</i>) to 1000 fm isobaths (all other krill); from the surface to 100 m deep (<i>E. pacifica</i>) to 400 m deep (all other krill)
Groundfish	80 species of groundfish occur in this area with 160 life stage combinations with designated EFH. The overall extent of groundfish EFH included wasters and substrates: With depths less than or equal to 3,500m to mean higher high water or the up-river extent of saltwater intrusion. Seamounts in depths greater than 3,5000 m as mapped Areas designated as HAPCs no already identified by the above criteria			
Common Thresher Shark	None	NA	None	Found in warmers waters up the cost to the mouth of the Columbia river
Bigeye Thresher Shark	None	NA	None	Found from 100 fm to 2000 fm from Cascade Head south.
Blue Shark	Neonate: From the 100 fm isobaths to the 1000fm isobaths	NA	From the 100 fm isobaths to the outer boundary of the EZZ	Beyond the 1000 fm isobaths

^a YOY (Young of the year): “All of the fish of a species that were born in the past year, from transformation to juvenile until January 1.” (USEPA 2015v)

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACDP	Air Contaminant Discharge Permits
ACHP	Advisory Council On Historic Preservation
ACS	American Community Survey
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ASPM	Aviation System Performance Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BCD	Building Codes Division
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BOR	Bureau of Reclamation
CAA	Clean Air Act
CCD	Common Core of Data
CCMP	Comprehensive Conservation and Management Plan
CCR	Consumer Confidence Reports
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFOI	Census of Fatal Occupational Injuries
CGP	Construction General Permit
CH ₄	Methane
CIMC	Cleanups in My Community
CMPA	Cooperative Management and Protection Area
CIO	Chief Information Officer
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COLT	Cell On Light Truck
COLT	Cell On Light Trucks
COW	Cell On Wheels
CRREL	Cold Regions Research and Engineering Laboratory
CRS	Community Rating System
CWA	Clean Water Act
CWS	Community Water Systems
DEQ	Department of Environmental Quality
DMV	Department of Motor Vehicles
DNR	Department of Natural Resources
DHHS	Department of Health and Human Services
DOE	Department of Energy
DWS	Drinking Water Services
EDACS	Enhanced Digital Access System
EIA	Energy Information Agency
EMS	Emergency Medical Services
EPCRA	Emergency Planning and Community Right to Know Act
ESU	Evolutionary Significant Units

Acronym	Definition
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highway Administration
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAP	Gap Analysis Program
GHG	Greenhouse Gas
GNIS	Geographic Names Information System
HAP	Hazardous Air Pollutant
HAPC	Habitat Areas of Particular Concern
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	Important Bird Areas
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
ISCP	Indirect Source Construction Permit
IWIN	Integrated Wireless Network
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LID	Low Impact Development
LMR	Land Mobile Radio
LRAPA	Lane Regional Air Protection Authority
LRR	Land Resource Regions
LTE	Long Term Evolution
MBTA	Migratory Bird Treaty Act
MDI	Methylene Diphenyl Diisocyanate
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
N2O	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
NASAO	National Association of State Aviation Officials
NCA	National Climate Assessment
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NESCA	Nongame and Endangered Species Conservation Act
NFIP	National Flood Insurance Program
NHA	National Heritage Areas
NHL	National Historic Landmarks
NHPA	National Historic Preservation Act
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology

Acronym	Definition
NM	Nautical Miles
NNL	National Natural Landmarks
NOC/AOP	Notice of Construction and Approval of Plans
NOTAM	Notices To Airmen
NO _x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
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
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
NWR	National Wildlife Refuges
OAC	Oregon Administrative Code
OAR	Oregon Administrative Rule
OBOLI	Oregon Bureau of Labor and Industries
OCIO	Office of the CIO
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ODOGAMI	Oregon Department of Geology and Mineral Industry
ODOT	Oregon Department of Transportation
ODSL	Oregon Department of State Lands
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OHA	Oregon Health Authority
OHA-PHD	Oregon Health Authority, Public Health Division
ONA	Outstanding Natural Area
OPRD	Oregon Parks and Recreation Department
OR	Oregon
ORBIC	Oregon Biodiversity Information Center
OR-OSHA	Oregon Occupational Safety and Health Administration
OSHA	Occupational Safety and Health Administration
ORS	Oregon Revised Statute
OTR	Ozone Transport Region
OWIN	Oregon Wireless Interoperability Network
PAB/PUB	Ponds and Aquatic Beds
PADUS	Protected Areas Database of the United States
PDX	Portland International Airport
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetlands
PFO	Palustrine Forested
PGA	Peak Ground Acceleration
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSCR	Public Safety Communications Research
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub

Acronym	Definition
PUC	Public Utility Commission
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
SAA	Sense and Avoid
SAIPE	Small Area Income and Poverty Estimates
SASP	State Aviation System Plan
SCEC	State Climate Extremes Committee
SDS	Safety Data Sheets
SEQRA	State Environmental Quality Review Act
SF ₆	Sulfur Hexafluoride
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO ₂	Sulfur Dioxide
SO ₃	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SO _x	Oxides of Sulfur
SPL	Sound Pressure Level
SRP	Statewide Radio Project
SRS	Statewide Radio System
STARCOMM	Siouxland Tristate Area Radio Communications
SUA	Special Use Airspace
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TNC	Transient Non-Community Systems
TRI	Toxics Release Inventory
TS	Terminology Services
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WCCCA	Washington County Consolidated Communications Agency
WCS	Wetlands Classification Standard
WES	Westside Express Service
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

REFERENCES

The citations in this Draft PEIS reflect the most recent information on the referenced site at the time the document was being written. If the site was updated after that point, the more recent information will be incorporated, as feasible, into the final document.

- 40 CFR 230.3(t). (1993, August 25). *Clean Water Act-Guidelines for Specification of Disposal Sites for Dredged or Fill Material*. Retrieved April 6, 2015, from <http://www.ecfr.gov/cgi-bin/text-idx?SID=7977290449ab243f2865159951305a77&node=40:25.0.1.3.24&rgn=div5>
- Advisory Council on Historic Preservation. (2004, August 5). *36 CFR Part 800 - Protection of Historic Properties*. Retrieved July 21, 2015, from Advisory Council on Historic Preservation: <http://www.achp.gov/regs-rev04.pdf>
- Agate Desert Technical Advisory Committee. (2007, April). *Agate Desert Vernal Pool Functional Assessment Methodology*. Retrieved December 3, 2015
- Agency for Toxic Substances and Disease Registry. (2006, March 22). *Public Health Assessment for Portland Harbor*. Retrieved November 19, 2015, from <http://www.atsdr.cdc.gov/HAC/pha/PortlandHarbor/PortlandHarborPHA032206.pdf>
- Aikens, C. M. (1993). *Archaeology of Oregon*. Portland: U.S. Department of the Interior; Bureau of Land Management; Oregon State Office.
- American Trails. (2015a, August 14). *National Trails Training Partnership*. Retrieved September 15, 2015, from <http://www.americantrails.org/resources/feds/NatTrSysOverview.html>
- American Trails. (2015b). *National Recreation Trails Database: Oregon*. Retrieved November 18, 2015, from http://www.americantrails.org/NRTDatabase/trailList.php?usrSortOrder=TrailName&maxRows_rsTrails=15000&usrTrailName=&usrTrailState=OR&usrTrailUse=&usrTrailCounty=&usrTrailUse2=&usrAgency=&usrYearDesignated=&usrTrailLength=0&usrTrailQuery=&usrTrailType=
- Ames, K. (2015). *Chapter 2 Review of the Archaeological Data*. Retrieved December 2015, from <http://www.nps.gov/archeology/kennewick/ames2.htm>
- Amtrak. (2015a, November). *West Train Routes*. Retrieved November 4, 2015, from Amtrak: <http://www.amtrak.com/west-train-routes>
- Amtrak. (2015b, April 6). *Amtrak System Timetable*. Retrieved from Amtrak: <https://www.amtrak.com/ccurl/194/703/System-Timetable-Spring-Fall-2015.pdf>
- Archaeological Institute of America. (2015, August). *Paisley Caves*. Retrieved 2016, from <http://www.archaeology.org/issues/145-1409/features/2370-peopling-the-americas-paisley-caves>
- Audubon Society of Portland. (2016). *Local Birding Information*. Retrieved June 24, 2016, from <http://audubonportland.org/local-birding>
- Balshe, W. (2011). *Power System Considerations for Cell Tower Applications*. Cummins Power Generation. Retrieved from <https://www.cumminspower.com/www/literature/technicalpapers/PT-9019-Cell-Tower-Applications-en.pdf>
- Bicho, N. F., Haws, J. A., & Davis, L. G. (Eds.). (2011). *Trekking the Shore: Changing Coastlines and the Antiquity of Coastal Settlement*. New York: Springer.

- BLM. (1984). *Manual 8400 - Visual Resource Management*. Washington: Department of the Interior, Bureau of Land Management.
- BLM. (2005). *Land Use Planning Handbook*. BLM Handbook H-1601-1. Retrieved March 2016, from http://www.blm.gov/wo/st/en/prog/planning/nepa/webguide/document_pages/land_use_planning.html
- BLM. (2012, June 28). *VRM System*. Retrieved October 7, 2015, from http://www.blm.gov/wo/st/en/prog/Recreation/recreation_national/RMS/2.html
- BLM. (2014a). *Welcome to BLM Facts*. Retrieved November 17, 2015, from 2014 BLM Facts: http://www.blm.gov/or/onlineservices/files/2014_BLM_Facts.pdf
- BLM. (2014b, 08). *DRECP Noise and Vibration*. Retrieved 07 22, 2015, from http://www.blm.gov/style/medialib/blm/ca/pdf/pa/energy/drecp/draft_drecp.Par.37401.File.dat/III.21%20Noise%20and%20Vibration.pdf
- BLM. (2014c). *Rockhounding/Casual Use/Mining*. Retrieved June 29, 2016, from <http://www.blm.gov/ca/st/en/fo/surprise/Rockhounding.html>
- BLM. (2015a). *Oregon/Washington BLM*. Retrieved November 2015, from <http://www.blm.gov/or/index.php>
- BLM. (2015b). *Recreation Sites*. Retrieved November 2015, from <http://www.blm.gov/or/districts/lakeview/recreation/index.php>
- BLM. (2015c). *National Conservation Lands: Oregon*. Retrieved November 17, 2015, from <http://www.blm.gov/or/nlcs/>
- BLM. (2015d). *Federal Land Policy and Management Act*. Retrieved October 7, 2015, from <http://www.blm.gov/flpma/>
- BLM. (2015e, March 27). *National Monuments*. Retrieved October 9, 2015, from http://www.blm.gov/co/st/en/BLM_Programs/national_landscape/national_monuments.html
- BLM. (2015f). *Yaquina Head Outstanding Natural Area*. Retrieved November 17, 2015, from <http://www.blm.gov/or/resources/recreation/yaquina/index.php>
- BLM. (2015g). *About Yaquina Head*. Retrieved November 17, 2015, from <http://www.blm.gov/or/resources/recreation/yaquina/about.php>
- BLM. (2015h). *Evidence of One of the Oldest Human Occupations in Western United States Discovered on BLM Land in Southeast Oregon*. Portland: Bureau of Land Management.
- BLM. (2015i, May 7). *Abandoned Mine Lands Portal*. Retrieved November 20, 2015, from <http://www.abandonedmines.gov/mapdata.html>
- BLM. (2015j). *Steens Mountain*. Retrieved November 17, 2015, from <http://www.blm.gov/or/districts/burns/recreation/steens-mtn.php>
- BLM. (2016a, April 22). *About Burns*. Retrieved April 22, 2016, from <http://www.blm.gov/or/districts/burns/about.php>
- BLM. (2016b, April 22). *About Lakeview*. Retrieved April 22, 2016, from <http://www.blm.gov/or/districts/lakeview/about.php>
- BLM. (2016c). *Oregon/Washington -- Forestry*. Retrieved July 1, 2016, from <http://www.blm.gov/or/resources/forests/>
- BLS. (2013a). *Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2013 (Oregon)*. Retrieved November 19, 2015, from <http://www.bls.gov/iif/oshwc/osh/os/pr136or.pdf>

- BLS. (2013b). *Incidence rate and number of nonfatal occupational injuries by industry and ownership, 2013 (U.S.)*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/osh/os/ostb3966.pdf>
- BLS. (2013c). *Fatal occupational injuries to private sector wage and salary workers, government workers, and self-employed workers by industry, all United States, 2013*. Retrieved September 22, 2015, from <http://www.bls.gov/iif/oshwc/cfoi/cftb0279.pdf>
- BLS. (2014). *Table A-5. Fatal occupational injuries by occupation and event or exposure, all United States, 2014*. Retrieved September 29, 2015, from 2014 Census of Fatal Occupational Injuries (preliminary data): <http://www.bls.gov/iif/oshwc/cfoi/cftb0290.pdf>
- BLS. (2015a). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages*. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages, file staadata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsncp16.htm>
- BLS. (2015b). *Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages*. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages, file staadata.zip. Retrieved April 2015, from <http://www.bls.gov/lau/rdsncp16.htm>
- BLS. (2015c, March 25). *May 2014 State Occupational Employment and Wage Estimates Oregon*. Retrieved November 19, 2015, from Occupational Employment Statistics: http://www.bls.gov/oes/current/oes_or.htm#49-0000
- BLS. (2015d, April 22). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved November 18, 2015, from Injuries, Illnesses, and Fatalities: http://www.bls.gov/iif/state_archive.htm#OR
- BLS. (2015e). *State Occupational Injuries, Illnesses, and Fatalities*. Retrieved November 19, 2015, from Bureau of Labor Statistics: http://www.bls.gov/iif/state_archive.htm#OR
- BLS. (2015f, September 21). *Census of Fatal Occupational Injuries (CFOI) - Current and Revised Data*. Retrieved September 18, 2015, from Census of Fatal Occupational Injuries (2011 forward): <http://www.bls.gov/iif/oshcfoi1.htm>
- BLS. (2015g, May). *U.S. Bureau of Labor Statistics*. Retrieved from May 2015 State Occupational Employment and Wage Estimates Oregon: http://www.bls.gov/oes/current/oes_or.htm
- BLS. (2016, March 30). *Telecommunications: NAICS 517*. Retrieved from Industries at a Glance: <http://www.bls.gov/iag/tgs/iag517.htm>
- Bond, S., Sims, S., & Dent, P. (Eds.). (2013). *Towers, Turbines, and Transmission Lines: Impacts on Property Value*. Chichester, West Sussex, United Kingdom: Wiley-Blackwell.
- Boyd, R. (1999). *The Coming of the Spirit of Pestilence: Introduced Infectious Diseases and Population Decline among Northwest Coast Indians, 1774-1874*. Seattle and London: University of Washington Press.
- Bureau of Planning - Portland, Oregon. (1991). *PortlandOregon.gov*. Retrieved November 19, 2015, from Scenic Resources Protection Plan: <https://www.portlandoregon.gov/bps/article/89965>
- Bureau of Reclamation. (2009, January 1). *Reclamation Manual*. Retrieved October 20, 2015, from Reclamation/ Recreation/ Policies and Directives and Standards: <http://www.usbr.gov/recman/lnd/lnd01-03.pdf>

- Bureau of Reclamation. (2015a). *Pacific Northwest Region Oregon Projects*. Retrieved November 2015, from <http://www.usbr.gov/pn/about/oregon.html>
- Bureau of Reclamation. (2015b, September 30). *Recreation*. Retrieved October 20, 2015, from Bureau of Reclamation: <http://www.usbr.gov/recreation/index.html>
- Bureau of Reclamation. (2015c). *Recreation Map - Oregon*. (U.S. Bureau of Reclamation) Retrieved November 19, 2015, from <http://www.usbr.gov/recreation/mapNew.cfm>
- Bureau of Reclamation. (2015d). *Photo of the Week 3-3-15*. Retrieved June 28, 2016, from http://www.usbr.gov/mp/headlines/2015/March/Photo_of_the_Week3-3-15.pdf
- Carter, R., McAllister, M., & Isleib, M. (1995). *Chapter 27: Mortality of Marbled Murrelets in Gill Nets in North America*. Retrieved June 2016, from USDA Forest Service Gen. Tech. Rep. PSW-152: http://www.fs.fed.us/psw/publications/documents/psw_gtr152/psw_gtr152_chap27.pdf
- CEC. (2011, April). *North American Terrestrial Ecoregions - Level III*. Retrieved from USEPA Ecoregions of North America: ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf
- Centers for Disease Control and Prevention. (2015a, September 17). CDC WONDER: Underlying Cause of Death, 1999-2013 Results. Retrieved November 18, 2015, from <http://wonder.cdc.gov/>
- Centers for Disease Control and Prevention. (2015b, September 15). *National Environmental Public Health Tracking Network*. Retrieved November 19, 2015, from <http://ephtracking.cdc.gov/showHome.action>
- CEQ. (1997, December). *Environmental Justice: Guidance Under the National Environmental Policy Act*. Retrieved April 2015, from http://energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-EJGuidance.pdf
- CEQ. (2014). *Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions*. Retrieved June 2014, from <https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance>
- CIO Council. (2015). *Data Center Consolidation and Optimization*. Retrieved from <https://cio.gov/drivingvalue/data-center-consolidation/>
- City of Eugene Oregon. (2015). *Art in Public Places*. Retrieved November 2015, from <https://www.eugene-or.gov/index.aspx?NID=731>
- City of Lincoln. (2015). *What are Saline Wetlands?* Retrieved July 2015, from <http://lincoln.ne.gov/city/parks/parksfacilities/wetlands/wetlandsinfo.htm>
- Climate Central. (2014, June). *California, Oregon, Washington and the Surging Seas*. Retrieved from A Vulnerability Assessment with Projections for Sea Level Rise and Coastal Flood Risk: <http://sealevel.climatecentral.org/uploads/ssrf/Report-CA-OR-WA.pdf>
- Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of wetlands and deepwater habitats of the United States, FWS/OBS-79/31*. Retrieved April 5, 2015, from <http://www.fws.gov/wetlands/Documents/classwet/index.html>
- CSC. (2007, March). *Telecommunications Facilities: An Illustrated Primer on the Siting of Facilities within Connecticut and Throughout the Nation*. Retrieved from Connecticut Sitting Council: http://www.ct.gov/csc/lib/csc/csc_tower_3_07.pdf
- Davies, W. (1984). *Engineering Aspects of Karst*. Retrieved December 2015, from http://pubs.usgs.gov/of/2004/1352/data/USA_karst.pdf

- De-Campos, A., Mamedov, A., & Huang, C.-h. (2009). Short-Term Reducing Conditions Decrease Aggregation. *Soil Science Society of America Journal*, 550-559. Retrieved November 2013, from <http://www.sciencedaily.com/releases/2009/04/090408140204.htm>
- Dello, K. (2015). *Oregon's Climate the Cocorah's State Climates Series*. Retrieved from The Two Faces of Oregon: http://www.cocorahs.org/Media/docs/ClimateSum_OR.pdf
- Di Gregorio, A., & Jansen, L. J. (1998). *Land Cover Classification System (LCCS): Classification Concepts and User Manual*. Rome: Food and Agriculture Organization of the United Nations.
- Diesel Service & Supply. (2016, June). *Approximate Diesel Fuel Consumption Chart*. Retrieved from http://www.dieselserviceandsupply.com/Diesel_Fuel_Consumption.aspx
- DoD. (2014). *Base Structure Report - Fiscal Year 2014 Baseline; A Summary of the Real Property Inventory*. Retrieved September 2015, from <http://www.acq.osd.mil/eie/>
- DOE. (2015). *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions*. Washington, DC: Department of Energy. Retrieved December 15, 2015
- DOI - Office of Surface Mining Reclamation and Enforcement. (2015a, November 20). e-AMLIS Advanced Query. Retrieved November 20, 2015, from <http://amlis.osmre.gov/QueryAdvanced.aspx>
- DOI - Office of Surface Mining Reclamation and Enforcement. (2015b, May 26). *Mine Fires and Burning Refuse*. Retrieved from Mine Fires: <http://www.osmre.gov/programs/tdt/minefires.shtm>
- DOT, F. (2015). *Federal Railroad Administration Horn Noise FAQ*. Retrieved 07 22, 2015, from <https://www.fra.dot.gov/Page/P0599>
- Ducks Unlimited. (2015). *Pacific Flyway*. Retrieved from <http://www.ducks.org/conservation/where-we-work/flyways/du-projects-pacific-flyway>
- Edinger, G. J., Evans, D. J., Gebauer, S., Howard, T. G., Hunt, D. M., & Olivero, A. M. (2014, March). *Ecological Communities of New York State*. Retrieved March 19, 2015, from A revised and expanded edition of Carol Reschke's *Ecological Communities of New York State*: <http://www.dec.ny.gov/animals/97703.html>
- EIA. (2011, July). *Greenhouse Gas Emissions Overview*. Retrieved July 28, 2015, from Emissions of Greenhouse Gases in the United States: http://www.eia.gov/environment/emissions/ghg_report/ghg_overview.cfm
- EIA. (2015a, November). *Electricity Data Browser-Oregon*. Retrieved November 2015, from U.S. Energy Information Administration: <http://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvo&geo=000000000002&sec=g&linechart=ELEC.GEN.ALL-OR-99.A&columnchart=ELEC.GEN.ALL-OR-99.A&map=ELEC.GEN.ALL-OR-99.A&freq=A&ctype=linechart<ype=pin&rtype=s&pin=&rse=0&motype=0>
- EIA. (2015b, November). *Oregon Profile Overview*. Retrieved November 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/?sid=OR#tabs-2>
- EIA. (2015c, October 15). *Oregon State Energy Profile*. Retrieved December 3, 2015, from U.S. Energy Information Administration: <http://www.eia.gov/state/print.cfm?sid=OR>
- EIA. (2015d). *State CO2 Emissions - 2000 to 2013*. Retrieved April 20, 2016, from <http://www.eia.gov/environment/emissions/state/analysis/>

- EIA. (2015e, October 28). *Oregon Carbon Dioxide Emissions from Fossil Fuel Consumption (1980-2013)*. Retrieved June 2016, from State Carbon Dioxide Emissions: <http://www.eia.gov/environment/emissions/state/excel/oregon.xlsx>
- EIA. (2015f, October 15). *Oregon - State Profile and Energy Estimates*. Retrieved November 12, 2015, from <http://199.36.140.204/state/?sid=OR>
- EIA. (2015g, October). *Table 1. State energy-related carbon dioxide emissions by year (2000-2013) (cont.)*. Retrieved June 2016, from Energy-Related Carbon Dioxide Emissions at the State Level, 2000-2013: <http://www.eia.gov/environment/emissions/state/analysis/pdf/table1.pdf>
- EIA. (2015h). *Profile Overview*. Retrieved 11 23, 2015, from <http://www.eia.gov/state/?sid=OR#tabs-2>
- EIA. (2015i, July 7). *How much carbon dioxide is produced by burning gasoline and diesel fuel?* Retrieved September 21, 2015, from <http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11>
- EIA. (2016). *Glossary - Electricity*. Retrieved from U.S. Energy Information Administration: <https://www.eia.gov/tools/glossary/?id=electricity>
- Elias, T. S. (1989). *Field Guide to North American Trees*. Grolier Book Clubs. Retrieved from <http://catalog.hathitrust.org/Record/004516358>
- Executive Office of the President. (1994, February). *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*. Retrieved April 2015, from 59 Federal Register 7629: <https://federalregister.gov/a/94-3685>
- FAA. (2007, 08 26). *Hearing and Noise in Aviation*. Retrieved 07 22, 2015, from https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing_brochure.pdf
- FAA. (2008). *Chapter 14 Airspace*. Retrieved June 2015, from Pilot's Handbook of Aeronautical Knowledge: http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/media/phak%20-%20chapter%2014.pdf
- FAA. (2012, 04 05). *Advisory Circular AC 36-3H*. Retrieved 07 22, 2015, from http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC36-3H%20Chg%201.pdf
- FAA. (2013). *Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) Roadmap*. Retrieved from https://www.faa.gov/uas/legislative_programs/uas_roadmap/media/UAS_Roadmap_2013.pdf
- FAA. (2014, January). *Federal Aviation Administration, Air Traffic Organization*. Retrieved June 2015, from http://www.faa.gov/about/office_org/headquarters_offices/ato/
- FAA. (2015a, June 25). *Airport Data and Contact Information*. Retrieved November 4, 2015, from http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015b, September 22). *CY14 Passenger Boardings at Commercial Service Airports*. Retrieved November 4, 2015, from http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy14-commercial-service-enplanements.pdf
- FAA. (2015c, March). *Flight Standards District Offices (FSDO)*. Retrieved June 2015, from http://www.faa.gov/about/office_org/field_offices/fsdo/?state=OR

- FAA. (2015d). *Aeronautical Information Manual*. Retrieved August 2015, from http://www.faa.gov/air_traffic/publications/media/aim.pdf
- FAA. (2015e). *Obstruction Evaluation / Airport Airspace Analysis (OE/AAA)*. Retrieved July 2015, from Federal Aviation Administration: <https://oeaaa.faa.gov/oeaaa/external/portal.jsp>
- FAA. (2015f, August 6). *FAA Air Traffic Organization Policy, JO 7400.9Y, Airspace Designations and Reporting Points*. (F. A. U.S. Department of Transportation, Producer) Retrieved October 2015, from FAA, Regulations & Policies, Orders & Notices: http://www.faa.gov/documentLibrary/media/Order/JO_7400.9Y.pdf
- FAA. (2015g). *Air Traffic Organization Policy Order JO 7400, 8Y Special Use Airspace*. Retrieved July 2015, from [http://www.faa.gov/documentLibrary/media/Order/7400.8Y_\(2016\).pdf](http://www.faa.gov/documentLibrary/media/Order/7400.8Y_(2016).pdf)
- FAA. (2015h). *FAA TFR List*. Retrieved July 2015, from <http://tfr.faa.gov/tfr2/list.html>
- FAA. (2015i, August). *FAA Pilot Safety Brochure - Hearing and Noise in Aviation*. Retrieved 08 05, 2015, from https://www.faa.gov/pilots/safety/pilotsafetybrochures/media/hearing_brochure.pdf
- FAA. (2016). *Airport and Data Contact Information (Utah)*. Retrieved June 7, 2016, from http://www.faa.gov/airports/airport_safety/airportdata_5010/menu/
- FCC. (2000, August). *Deployment of Advanced Telecommunications Capability: Second Report*. Retrieved Nov 16, 2015, from https://transition.fcc.gov/Bureaus/Common_Carrier/Orders/2000/fcc00290.pdf
- FCC. (2012, March 13). *Final Programmatic Environmental Assessment for the Antenna Structure Registration Program*. Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-312921A1.pdf
- FCC. (2013). *Universal Service Monitoring Report*. Retrieved from https://apps.fcc.gov/edocs_public/attachmatch/DOC-330829A1.pdf
- FCC. (2014a). *Internet Access Services: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau. Federal Communications Commission.
- FCC. (2014b). *Local Telephone Competition: Status as of December 31, 2013*. Industry Analysis and Technology Division Wireline Competition Bureau.
- FCC. (2015a). *Master PSAP Registry, V 2.0*. Retrieved from <https://www.fcc.gov/general/9-1-1-master-psap-registry>
- FCC. (2015b, June 17). *Antenna Structure Registration*. Retrieved June 17, 2015, from Federal Communications Commission: <http://wireless2.fcc.gov/UlsApp/AsrSearch/asrRegistrationSearch.jsp>
- FCC. (2016a, March). *National Broadband Plan Chapter 16 Public Safety*. Retrieved March 29, 2016, from Broadband.gov: <http://www.broadband.gov/plan/16-public-safety/>
- FCC. (2016b, February 1). *Tower and Antenna Siting*. Retrieved February 10, 2016, from <https://www.fcc.gov/general/tower-and-antenna-siting>
- FCC. (2016c, June). *Detail - Microwave*. Retrieved from Application Search Help: http://wireless2.fcc.gov/helpfiles/applicationSearch/ad_microwave.html
- Federal Mining Dialogue. (2015, January 6). *Abandoned Mine Lands Portal - Staying Safe*. Retrieved September 29, 2015, from <http://www.abandonedmines.gov/ss.html>

- FEMA. (2000). *44 CFR Section 59.1 of the National Flood Insurance Program (NFIP) Regulations: Definitions of NFIP Terms*. Retrieved May 2015, from <http://www.fema.gov/media-library/assets/documents/12437?id=3064>
- FEMA. (2010, March). *Guidelines for Estimation of Percolation losses for NFIP Studies*. Retrieved August 6, 2015, from http://www.fema.gov/media-library-data/20130726-1731-25045-9495/dl_perc.pdf
- FEMA. (2013). *Unit 3: NFIP Flood Studies and Maps*. Retrieved May 2015, from http://www.fema.gov/media-library-data/20130726-1539-20490-0241/nfip_sg_unit_3.pdf
- FEMA. (2014a, May). *Chapter 8: Floodplain Natural Resources and Functions*. Retrieved May 2015, from <https://training.fema.gov/hiedu/docs/fmc/chapter%208%20-%20floodplain%20natural%20resources%20and%20functions.pdf>
- FEMA. (2014b, May). *The National Flood Insurance Program Community Status Book*. Retrieved May 2015, from <http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book>
- FEMA. (2014c, May). *Chapter 2: Types of Floods and Floodplains*. Retrieved May 2015, from <http://training.fema.gov/hiedu/docs/fmc/chapter%202%20-%20types%20of%20floods%20and%20floodplains.pdf>
- FEMA. (2014d, May). *Community Rating System*. Retrieved May 2015, from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communitites_May_1_2014.pdf
- FEMA. (2014e, June). *Community Rating System*. Retrieved from http://www.fema.gov/media-library-data/1398878892102-5cbcaa727a635327277d834491210fec/CRS_Communitites_May_1_2014.pdf
- FEMA. (2015, April). *Floodplain Management Fact Sheet*. Retrieved May 2015, from <https://www.fema.gov/floodplain-management-fact-sheet>
- Fenneman, N. (1916). *Physiographic Subdivision of the United States*. Retrieved April 2015, from <http://www.pnas.org/content/3/1/17.full.pdf?ck=nck>
- FGDC. (2013, August). *Classification of Wetlands and Deepwater Habitats of the United States*. Retrieved April 17, 2015, from FGDC Subcommittee on Wetlands Data: <http://www.fgdc.gov/standards/projects/FGDC-standards-projects/wetlands/nvcs-2013>
- FHWA. (2009, October). *Advances in Wildlife Crossing Technologies*. Retrieved July 12, 2016, from Public Roads: <http://www.fhwa.dot.gov/publications/publicroads/09septoct/03.cfm>
- FHWA. (2011, 7 14). *Highway Traffic and Construction Noise*. Retrieved 07 27, 2015, from [fhwa.dot.gov](http://www.fhwa.dot.gov): http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/probresp.cfm#appendix
- FHWA. (2013, September 3). *National Scenic Byways Program - Intrinsic Qualities: Identification and Distinctions*. Retrieved May 2016, from http://www.fhwa.dot.gov/hep/scenic_byways/byway_quality/analysis/iq_identification.cfm
- FHWA. (2014a, October 21). *Public Road Length*. Retrieved November 4, 2015, from <http://www.fhwa.dot.gov/policyinformation/statistics/2013/hm10.cfm>
- FHWA. (2014b, October 1). *National Scenic Byways Program*. Retrieved April 8, 2015, from http://www.fhwa.dot.gov/hep/scenic_byways/
- FHWA. (2015a, May 28). *Bridges by State and County 2014*. Retrieved November 4, 2015, from <http://www.fhwa.dot.gov/bridge/nbi/no10/county14c.cfm#or>

- FHWA. (2015b, November). *Route Log and Finder List*. Retrieved November 4, 2015, from Federal Highway Administration: <http://www.fhwa.dot.gov/reports/routefinder/#s09>
- FHWA. (2015c). *America's Byways: Oregon*. Retrieved November 16, 2015, from <http://www.fhwa.dot.gov/byways/states/OR>
- FHWA. (2015d, 05 28). *Highway Traffic Noise*. Retrieved 07 22, 2015, from http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm
- Fiber Optic Association. (2010). *Guide to Fiber Optics & Premises Cabling*. Retrieved September 21, 2015, from Safety in Fiber Optic Installations: <http://www.thefoa.org/tech/safety.htm>
- FTA. (2006). *Transit Noise and Vibration Impact Assessment*. FTA.
- GAO. (2013). *Data Center Consolidation: Strengthened Oversight Needed to Achieve Billions of Dollars in Savings*. Retrieved from <http://www.gao.gov/products/GAO-13-627T>
- GLOBE SCRC. (2015). *GLOBE Student Climate Research Center*. Retrieved from <http://www.globe.gov/web/scrc/overview>
- Hill, D. e. (1997). Bird Disturbance: Improving the Quality and Utility of Disturbance Research. *Journal of Applied Ecology*, 34(2): 275-288.
- Historic American Buildings Survey. (1933a). William Parker House, Gervais, Marion, OR. *Library of Congress Prints and Photographs Online Collection*. Gervais, Oregon: Library of Congress. Retrieved December <http://www.loc.gov/resource/hhh.or0035.photos>, 2015
- Historic American Buildings Survey. (1933b). West and South (rear) Facades - U.S. Courthouse, 620 Southwest Main Street, Portland, Multnomah County, OR. *Library of Congress Prints and Photographs Online Collection*. Portland, Oregon: Library of Congress. Retrieved December 2015, from <http://www.loc.gov/resource/hhh.or0141.photos/?sp=1>
- Historic American Buildings Survey. (1933c). East elevation. Completed 1875. Davidson Photograph, Courtesy of Oregon Historical Society. - Pioneer Post Office, 700 SW Sixth Avenue, Portland, Multnomah County, OR. *Library of Congress Prints and Photographs Online Collection*. Portland, Oregon: Library of Congress. Retrieved December 2015, from <http://www.loc.gov/resource/hhh.or0030.photos/?sp=1>
- Historic American Engineering Record. (1968a). Goodbye Creek Bridge. View W. - Crater Lake National Park Roads, Goodbye Creek Bridge, Spanning Goodbye Creek at Munson Valley Road, Klamath Falls, Klamath County, OR. *Library of Congress Prints and Photographs Online Collection*. Klamath Falls, Oregon: Library of Congress. Retrieved December 2015, from <http://www.loc.gov/resource/hhh.or0477.photos/?sp=1>
- Historic American Engineering Record. (1968b). Upsteam View Looking West - Short Bridge, Spanning South Santiam River at High Deck Road, Cascadia, Linn County, OR. *Library of Congress Prints and Photographs Online Collection*. Cascadia, Oregon: Library of Congress. Retrieved December 2015, from <http://www.loc.gov/resource/hhh.or0493.photos/?sp=8>
- Idaho State University. (2000). *Environmental Geology*. Retrieved March 20, 2016, from http://geology.isu.edu/wapi/EnvGeo/EG4_mass_wasting/EG_module_4.htm
- Institute of Maritime History. (2015, August). *Rainsford Island Archaeological Survey*. Retrieved August 2015, from <http://www.maritimehistory.org/content/rainsford-island-archaeological-survey>
- International Finance Corporation. (2007, April 30). *Environmental, Health, and Safety Guidelines for Telecommunications*. Retrieved from

- <http://www.ifc.org/wps/wcm/connect/0985310048855454b254f26a6515bb18/Final+-+Telecommunications.pdf?MOD=AJPERES&id=1323152343828>
- IPCC. (2007). *Climate Change 2007: Synthesis Report*. Retrieved 2015, from Intergovernmental Panel on Climate Change: www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis*. Intergovernmental Panel on Climate Change. Retrieved from <https://www.ipcc.ch/report/ar5/wg1/>
- ITU-T. (2012). *Series L: Construction, Installation and Protection of Cables and Other Elements of Outside Plant*. International Telecommunication Union, Telecommunication Standardization Sector of ITU, Geneva.
- Jenkins, D. J., Connolly, T. J., & Aikens, C. M. (Eds.). (2004). *Early and Middle Holocene Archaeology of the Northern Great Basin*. Eugene, Oregon: University of Oregon Museum of Natural History and Department of Anthropology.
- Johnson, M. J. (2009). *Understanding the Habitat Needs of the Declining Western Yellow-billed Cuckoo*. Retrieved from <http://pubs.usgs.gov/fs/2009/3091/fs2009-3091.pdf>
- Keep Oregon Cool. (2009). *Oregon Global Warming Commission*. Retrieved 2015, from <http://www.keeporegoncool.org/content/oregon-global-warming-commission>
- Kottek, M. (2006). *World Map of the Köppen-Geiger Climate Classification*. Offenbach, Germany and Vienna, Austria: Gebrüder Borntraeger.
- Lew, A. (2004). *Chapter 9 - The Mountain West and Southwest*. Retrieved April 2015, from Northern Arizona University: <http://www.geog.nau.edu/courses/alew/gsp220/text/chapters/ch9.html>
- Lewis, H. T. (1973). *Patterns of Indian Burning in California: Ecology and Ethnohistory*. Madison: University of Wisconsin.
- Lower Columbia Estuary Partnership. (1999). *Lower Columbia River Estuary Plan*. Retrieved June 28, 2016, from http://www.estuarypartnership.org/sites/default/files/ccmp_final_ch3.pdf
- Lower Columbia Estuary Partnership. (2011). *2011 Comprehensive Conservation and Management Plan Update*. Retrieved December 7, 2015, from <http://www.estuarypartnership.org/who-we-are/our-management-plan>
- Lower Columbia Estuary Partnership. (2015). *Quick Facts*. Retrieved December 7, 2015, from <http://www.estuarypartnership.org/learn/quick-facts>
- LRAPA. (2008, October 14). *Regulation Section 48-015, Rules for Fugitive Emissions, General Requirements*. Retrieved November 19, 2015, from <http://or-lanerapa.civicplus.com/DocumentCenter/Home/View/276>
- LRAPA. (2011a, April 25). *Title 50, Ambient Air Standards and PSD Increments*. Retrieved November 19, 2015, from <http://or-lanerapa.civicplus.com/DocumentCenter/Home/View/278>
- LRAPA. (2011b, April 25). *Title 12, General Provisions and Definitions*. Retrieved November 19, 2015, from <http://or-lanerapa.civicplus.com/DocumentCenter/Home/View/249>
- LRAPA. (2011c, April 25). *Title 38, Major New Source Review*. Retrieved November 19, 2015, from <http://or-lanerapa.civicplus.com/DocumentCenter/Home/View/267>
- LRAPA. (2011d, April 25). *Title 34, Stationary Source Notification Requirements*. Retrieved from <http://or-lanerapa.civicplus.com/DocumentCenter/Home/View/261>
- LRAPA. (2015). *LRAPA 2014 Annual Report*. Retrieved November 19, 2015, from <http://www.lrapa.org/ArchiveCenter/ViewFile/Item/329>

- Merriam Webster Dictionary. (2015a). *Airspace*. Retrieved June 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/airspace>
- Merriam Webster Dictionary. (2015b). *Sea Level*. Retrieved July 2015, from Merriam Webster Dictionary: <http://www.merriam-webster.com/dictionary/sea%20level>
- Moody, D. W., Carr, J., Chase, E. B., & Paulson, R. W. (1986). *National Water Summary 1986 - Hydrologic Events and Ground-Water Quality*. Retrieved April 5, 2015, from <http://pubs.er.usgs.gov/publication/wsp2325>
- Morlan, J. C., Blok, E. F., Miner, J., & Kirchner, W. N. (2010). *Wetland and Land Use Change in the Willamette Valley, Oregon: 1994 to 2005*. Retrieved December 1, 2015, from U.S. Fish and Wildlife Service, Portland, Oregon, and Oregon Department of State Lands: https://www.oregon.gov/dsl/PERMITS/docs/land_use_change_1994-2005.pdf
- NASA. (2013). *Final Environmental Impact Statement for the Sounding Rockets Program at Poker Flat Research Range*. Retrieved July 1, 2016, from <http://netpublic.grc.nasa.gov/main/NASA%20SRP%20at%20PFRR%20FEIS%20Volume%20I.pdf>
- National Association of State Aviation Officials (NASAO). (2015). *Resources NASAO National Association of State Aviation Officials*. Retrieved July 2015, from NASAO National Association of State Aviation Officials: <http://www.nasao.org/resources/>
- National Audubon Society. (2015). *Important Bird Areas-Oregon*. Retrieved December 16, 2015, from <http://netapp.audubon.org/iba/state/US-OR>
- National Audubon Society. (2016). *The Flyways -- Pacific Flyway*. Retrieved June 24, 2016, from <http://www.audubon.org/pacific-flyway>
- National Conference of State Legislators. (2015, February). *Federal and State Recognized Tribes*. Retrieved October 6, 2015, from <http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#fl>
- National Congress of American Indians. (2016, June). Retrieved June 2016, from <http://www.ncai.org/>
- National League of Cities. (2007). *Subcounty, General-Purpose Governments by Population-Size Group and State*. (Census of Governments) Retrieved May 21, 2015, from Number of Municipal Governments & Population Distribution: <http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-structures/number-of-municipal-governments-and-population-distribution>
- National Wild and Scenic Rivers System. (2015a). *Oregon*. Retrieved November 17, 2015, from <http://www.rivers.gov/oregon.php>
- National Wild and Scenic Rivers System. (2015b). *Malheur River (North Fork), Oregon*. Retrieved November 2015, from <http://www.rivers.gov/rivers/malheur-nf.php>
- National Wild and Scenic Rivers System. (2015c). *Deschutes River, Oregon*. Retrieved November 17, 2015, from <http://www.rivers.gov/rivers/deschutes.php>
- National Wild and Scenic Rivers System. (2016). *Snake River, Idaho, Oregon*. Retrieved July 1, 2016, from <https://www.rivers.gov/rivers/snake.php>
- National Wildlife Federation. (2015). *Ecoregions*. Retrieved from <http://www.nwf.org/Wildlife/Wildlife-Conservation/Ecoregions.aspx>
- Natural Heritage Advisory Council to the State Land Board. (2010). *Oregon Biodiversity Information Center: Natural Areas Program*. Retrieved November 17, 2015, from Oregon State University: Institute for Natural Resources: <http://orbic.pdx.edu/documents/2010NAP.pdf>

- Nelson, R. (2012). *The Description of Flowers*. Retrieved June 2016, from <https://www.cs.rochester.edu/~nelson/wildflowers/glossaries/flowers/index.html>
- New Hampshire Department of Environmental Services. (2014). *Geologic Mapping Program*. Retrieved August 2015, from <http://des.nh.gov/organization/commissioner/gsu/gmp/categories/overview.htm>
- NIH. (2015a, June). *What is TOXMAP?* Retrieved from National Institutes of Health: <http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-is-toxmap.html>
- NIH. (2015b, January 29). *TOXMAP Environmental Health Maps (Oregon)*. Retrieved November 19, 2015, from National Institutes of Health: http://toxmap-classic.nlm.nih.gov/toxmap/main/mapIt.do?regionID=230681DE34_1
- NIST. (2015, March). *Nationwide Public Safety Broadband Network Deployment: Network Parameter Sensitivity Analysis*. U.S. Department of Commerce. National Institute of Standards and Technology (NIST), Wireless Networks Division, Communications Technology Laboratory. Retrieved from <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8039.pdf>
- NMFS. (2012). *Final Rule to Revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle*. Retrieved from <http://www.nmfs.noaa.gov/pr/pdfs/fr/fr77-4170.pdf>
- NOAA. (1999). *Critical Habitat for Central California Coast and Southern Oregon - Northern California Coast ESU Coho Salmon*. Retrieved from <http://www.fisheries.noaa.gov/pr/pdfs/fr/fr64-24049.pdf>
- NOAA. (2008). *Critical Habitat for Oregon Coast ESU Coho Salmon*. Retrieved from <http://www.fisheries.noaa.gov/pr/pdfs/fr/fr73-7916.pdf>
- NOAA. (2014a). *Loggerhead Turtle (Caretta caretta)*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/turtles/loggerhead.html>
- NOAA. (2014b). *Olive Ridley Turtle (Lepidochelys olivacea)*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/turtles/oliveridley.htm>
- NOAA. (2015a). *South Slough National Estuarine Research Reserve*. Retrieved December 4, 2015, from <http://nerrs.noaa.gov/reserves/south-slough.html>
- NOAA. (2015b). *Flood Related Hazards*. Retrieved July 2015, from <http://www.floodsafety.noaa.gov/hazards.shtml>
- NOAA. (2015c). *Chinook Salmon*. Retrieved from <http://www.nmfs.noaa.gov/pr/species/fish/chinook-salmon.html>
- NOAA. (2015d). *Chum Salmon Species Summary*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/fish/chum-salmon.html>
- NOAA. (2015e). *Coho Salmon (Oncorhynchus kisutch)*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/fish/coho-salmon.html>
- NOAA. (2015f). *Sockeye Salmon Species Summary*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/fish/sockeye-salmon.html>
- NOAA. (2015g). *Species Summary for the Steelhead Trout*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/fish/steelhead-trout.html>
- NOAA. (2015h). *Leatherback Turtle (Dermochelys coriacea)*. Retrieved from <http://www.fisheries.noaa.gov/pr/species/turtles/leatherback.html>
- NOAA. (2015i). *Data Tools: 1981-2010 Normals*. Retrieved July 1, 2016, from Data Tools: 1981 - 2010 Normals: <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>

- NOAA. (2016a). *Habitat Areas of Particular Concern (HAPC)*. Retrieved June 24, 2016, from http://www.westcoast.fisheries.noaa.gov/habitat/habitat_types/HAPC.html
- NOAA. (2016b). *Maps of areas designated as HAPC*. Retrieved June 24, 2016, from http://www.westcoast.fisheries.noaa.gov/publications/gis_maps/maps/groundfish/map-gfish-hapc.pdf
- NOAA. (2016c). *Endangered and Threatened Species; Designation of Critical Habitat for Lower Columbia River Coho Salmon and Puget Sound Steelhead; Final Rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2016-02-24/pdf/2016-03409.pdf>
- NOAA. (2016d). *The Fujita Scale*. Retrieved July 1, 2016, from <http://www.srh.noaa.gov/oun/?n=tornadodata-okc-appendix>
- NOAA, USGS, SERPD, and USACE. (2012, December 6). *Global Sea Level Rise Scenarios for the United States National Climate Assessment*. Retrieved from https://scenarios.globalchange.gov/sites/default/files/NOAA_SLR_r3_0.pdf
- NPS. (1995, July 12). *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes*. Retrieved September 4, 2015, from National Park Service: <http://www.nps.gov/tps/standards/four-treatments/landscape-guidelines/index.htm>
- NPS. (2000). *Geologic Glossary*. Retrieved August 2015, from <https://www.nature.nps.gov/geology/usgsnps/misc/glossaryDtoI.html#G>
- NPS. (2003, January 16). *History E-Library*. Retrieved September 10, 2015, from <http://www.nps.gov/parkhistory/hisnps/NPSHistory/nomenclature.html>
- NPS. (2012a, July 17). *The National Trails System Act*. Retrieved April 12, 2015, from <http://www.nps.gov/nts/legislation.html>
- NPS. (2012b, June 28). *Oregon*. Retrieved November 22, 2015, from <http://www.nature.nps.gov/nnl/state.cfm?State=OR>
- NPS. (2013a, February 15). *Geologic Heritage Terms*. Retrieved September 18, 2015, from http://www.nature.nps.gov/geology/geoheritage/geologic_heritage_terms.cfm
- NPS. (2013b, December 10). *Geologic Hazards*. Retrieved September 1, 2015, from Geologic, Energy, and Mineral Resources: <http://www.nature.nps.gov/geology/hazards/>
- NPS. (2014a). *Earth Science Concepts -- Geology by Region*. Retrieved October 2015, from https://www.nature.nps.gov/geology/education/concepts/concepts_regional_geology.cfm
- NPS. (2014b). *Earth Science Concepts*. Retrieved November 2015, from https://www.nature.nps.gov/geology/education/concepts/concepts_cascadesierra.cfm
- NPS. (2014c). *Earth Science Concepts*. Retrieved December 2015, from http://nature.nps.gov/geology/education/concepts/concepts_regional_geology.cfm
- NPS. (2014d, June 20). *Prohibition of Unmanned Aircraft in National Parks*. Retrieved June 2015, from <https://www.nps.gov/gaar/learn/news/prohibition-of-unmanned-aircraft-in-national-parks.htm>
- NPS. (2014e, October 22). *National Natural Landmarks Program*. Retrieved April 21, 2015, from <http://nature.nps.gov/nnl/index.cfm>
- NPS. (2014f, September). *Oregon*. Retrieved November 2015, from <http://www.nps.gov/state/or/index.htm>
- NPS. (2014g, June 16). *National Park Service Science of Sound*. Retrieved July 22, 2015, from <http://www.nature.nps.gov/sound/science.cfm>
- NPS. (2014h). *Learn about the National Historic Landmarks Program*. Retrieved June 30, 2016, from <https://www.nps.gov/nhl/learn/intro.htm>

- NPS. (2015a). *National Park Service, Find A Park - Oregon*. Retrieved November 2015, from <http://www.nps.gov/state/or/index.htm>
- NPS. (2015b). *Crater Lake National Park*. Retrieved November 2015, from <http://www.nps.gov/crla/index.htm>
- NPS. (2015c). *Oregon Caves National Monument and Preserve*. Retrieved November 2015, from <http://www.nps.gov/orca/index.htm>
- NPS. (2015d, April 27). *National Historic Landmarks Program*. Retrieved April 28, 2015, from <http://www.nps.gov/nhl/INDEX.htm>
- NPS. (2015e, February 18). *National Historic Landmarks Program*. Retrieved May 2016, from <https://www.nps.gov/nhl/>
- NPS. (2015f, April 15). *National Historic Landmarks Program: Oregon*. Retrieved November 18, 2015, from <http://www.nps.gov/nhl/find/statelists/or.htm>
- NPS. (2015g, November 17). *Fort Vancouver National Historic Site: Nature*. Retrieved November 17, 2015, from <http://www.nps.gov/fova/learn/nature/index.htm>
- NPS. (2015h, November 29). *Wilderness*. Retrieved November 29, 2015, from <http://wilderness.nps.gov/faqnew.cfm>
- NPS. (2016). *Maritime-Related National Parks in Oregon*. Retrieved June 29, 2016, from <https://www.nps.gov/maritime/parks/or.htm>
- NRCS. (1996a). *Soil Quality Resource Concerns: Soil Erosion*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051278.pdf
- NRCS. (1996b). *Soil Quality Resource Concerns: Compaction*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051594.pdf
- NRCS. (2000, March). *Soil Quality - Urban Technical Note No. 1*. Retrieved from Erosion and Sedimentation on Construction Sites: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053285.pdf
- NRCS. (2003). *Soil Compaction: Detection, Prevention, and Alleviation*. Retrieved September 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_053258.pdf
- NRCS. (2006). *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Retrieved May 2015, from Major Land Resource Area: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051845.pdf
- NRCS. (2015a). *STATSGO2 Database*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053629
- NRCS. (2015b). *Hydric Soils -- Introduction*. Retrieved June 2015, from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/hydric/?cid=nrcs142p2_053961
- NRCS. (2015c). *What is Soil?* Retrieved June 2015, from Soil Education: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054280
- NRCS. (2015d). *Twelve Orders of Soil Taxonomy*. Retrieved August 2015, from Soils: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_053588
- NRCS. (2015e). *Using Soil Taxonomy to Identify Hydric Soils*. Retrieved July 2015, from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010785.pdf
- NRCS. (2015f). *Erosion*. Retrieved September 2015, from <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/landuse/crops/erosion/>
- NTFI. (2005). *Why Can't We Talk? Working Together to Bridge the Communications Gap to Save Lives: A Guide for Public Officials*. U.S. Department of Justice, Office of Justice

- Programs, National Institute of Justice. National Task Force on Interoperability (NTFI). Retrieved from <https://www.ncjrs.gov/pdffiles1/nij/204348.pdf>
- NTIA. (2005, October). *Interference Protection Criteria Phase 1 - Compilation from Existing Sources*. Retrieved January 6, 2016, from NTIA Report 05-432: https://www.ntia.doc.gov/files/ntia/publications/ipc_phase_1_report.pdf
- NTIA. (2014). *Download Data*. Retrieved from National Broadband Map: <http://www.broadbandmap.gov/data-download>
- NWS. (2011a, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: <http://www.srh.noaa.gov/jetstream//global/climate.htm#map>
- NWS. (2011b, October 21). *National Weather Service: JetStream - Online School for Weather*. Retrieved from National Oceanic and Atmospheric Administration: http://www.srh.noaa.gov/jetstream//global/climate_max.htm
- NWS. (2015a). *Flooding in Oregon*. Retrieved from <http://www.floodsafety.noaa.gov/states/or-flood.shtml>
- NWS. (2015b, June 10). *Office of Climate, Water, and Weather Services*. Retrieved October 19, 2015, from 2014 Summary of Hazardous Weather Fatalities, Injuries, and Damage by State: <http://www.nws.noaa.gov/om/hazstats/state14.pdf>
- OCMP. (2015). *Estuaries*. Retrieved December 3, 2015, from http://www.oregon.gov/LCD/OCMP/pages/est_intro.aspx
- ODA. (2015a). *Noxious Weed Policy Classification*. Retrieved from <http://www.oregon.gov/ODA/shared/Documents/Publications/Weeds/NoxiousWeedPolicyClassification.pdf>
- ODA. (2015b). *Applegate's Milk-vetch (Astragalus applegatei)*. Retrieved from <http://www.oregon.gov/oda/shared/Documents/Publications/PlantConservation/AstragalusApplegateiProfile.pdf>
- ODA. (2015c). *McDonald's Rock-Cress (Arabis macdonaldiana)*. Retrieved from <http://www.oregon.gov/oda/shared/Documents/Publications/PlantConservation/ArabisMacdonaldianaProfile.pdf>
- ODA. (2015d). *Western Lily (Lilium occidentale)*. Retrieved from <http://www.oregon.gov/oda/shared/Documents/Publications/PlantConservation/LiliumOccidentaleProfile.pdf>
- ODF. (2015a). *Oregon Department of Forestry*. Retrieved June 30, 2016, from Management and Planning -- Forest Land Classification: <https://www.oregon.gov/ODF/Working/Pages/StateForests.aspx>
- ODF. (2015b). *State Forests*. Retrieved November 2015, from <http://www.oregon.gov/ODF/Working/Pages/StateForests.aspx>
- ODFW. (2014, September 17). *Mammals: Whale, dolphin and porpoise*. Retrieved June 2016, from Oregon Wildlife Species: http://www.dfw.state.or.us/species/mammals/whale_dolphin_porpois.asp#Top
- ODFW. (2015a). *Oregon Department of Fish and Wildlife*. Retrieved November 2015, from <http://www.dfw.state.or.us/agency/>
- ODFW. (2015b). *2005 Oregon Conservation Strategy*. Retrieved from http://www.dfw.state.or.us/conservationstrategy/read_the_strategy.asp
- ODFW. (2015c). *Saltwater Fishing*. Retrieved from <http://www.dfw.state.or.us/resources/fishing/saltwater.asp>

- ODFW. (2015d). *Oregon Wildlife Species: Cats*. Retrieved June 29, 2016, from <http://www.dfw.state.or.us/species/mammals/cats.asp>
- ODFW. (2015e). *ODFW Resources: The ODFW Visitors' Guide*. Retrieved November 16, 2015, from <http://www.dfw.state.or.us/resources/visitors/wildlife.asp>
- ODFW. (2016a). *Oregon Wildlife Species - Mammals*. Retrieved April 2016, from <http://www.dfw.state.or.us/species/mammals/index.asp#Bears>
- ODFW. (2016b). *Oregon Wildlife Species - Birds*. Retrieved April 2016, from http://www.dfw.state.or.us/species/birds/swans_ducks_geese.asp#Top
- ODFW. (2016c). *Oregon Wildlife Species: Raptors - Bald and Golden Eagles*. Retrieved April 2016, from <http://www.dfw.state.or.us/species/birds/raptors.asp>
- ODFW. (2016d). *Oregon Wildlife Species - Amphibians*. Retrieved April 2016, from <http://www.dfw.state.or.us/species/amphibians/#Salamanders>
- ODFW. (2016e). *Oregon Wildlife Species - Reptiles*. Retrieved April 2016, from <http://www.dfw.state.or.us/species/reptiles/index.asp#turtles>
- ODFW. (2016f). *Species: Conservation Summaries for Strategy Species*. Retrieved June 29, 2016, from http://www.dfw.state.or.us/conservationstrategy/docs/document_pdf/b-species_1.pdf
- ODFW. (2016g). *Oregon Wildlife Species*. Retrieved June 29, 2016, from Oregon Department of Fish and Wildlife: <http://www.dfw.state.or.us/species/fish/>
- ODFW. (2016h). *Oregon's Native Freshwater Fish Species*. Retrieved July 1, 2016, from <http://www.dfw.state.or.us/fish/crp/freshwater.asp>
- ODFW. (2016i). *Recreational Shellfish - Marine Shellfish and Invertebrates*. Retrieved April 2016, from <http://www.dfw.state.or.us/mrp/shellfish/regulations.asp>
- ODFW. (2016j). *Oregon Wildlife Species: Seals and Sea Lions*. Retrieved 2016, from http://www.dfw.state.or.us/species/mammals/seals_sea_lions.asp#Top
- ODFW. (2016k). *Invasive Species: Stop Their Spread*. Retrieved 2016, from http://www.dfw.state.or.us/conservationstrategy/invasive_species.asp
- ODFW. (2016l). *Oregon Wolf Conservation and Management 2015 Annual Report*. Retrieved June 29, 2016, from Oregon Department of Fish and Wildlife: http://dfw.state.or.us/Wolves/docs/oregon_wolf_program/2015_Annual_Wolf_Report_3-18-16_FINAL.pdf
- ODFW. (2016m). *Marine Mammal Species*. Retrieved 2016, from <http://www.dfw.state.or.us/MRP/mammals/species.asp>
- ODFW. (2016n). *Oregon Wildlife Species*. Retrieved 2016, from <http://www.dfw.state.or.us/species/amphibians/>
- ODFW. (2016o). *Oregon Wildlife Species*. Retrieved 2016, from Oregon Department of Fish and Wildlife: <http://www.dfw.state.or.us/species/reptiles/>
- ODFW. (2016p). *Invasive Species - Feral Swine*. Retrieved June 29, 2016, from http://www.dfw.state.or.us/conservationstrategy/invasive_species/feral_swine.asp
- ODFW. (2016q). *Oregon's Native Freshwater Fish Species*. Retrieved July 1, 2016, from <http://www.dfw.state.or.us/fish/crp/freshwater.asp>
- ODLCD. (2000, July). *Planning for Natural Hazards: Flood Technical Resources Guide*. Retrieved December 2, 2015, from http://www.oregon.gov/LCD/HAZ/docs/floods/04_flood.pdf
- ODOE. (2013). *Oregon Greenhouse Gas Inventory*. Retrieved 12 1, 2015, from http://www.oregon.gov/deq/AQ/Documents/OregonGHGinventory07_17_13FINAL.pdf

- ODOT. (2014, September 18). *Oregon State Rail Plan*. Retrieved November 4, 2015, from https://www.oregon.gov/ODOT/TD/TP/RailPlan/Adopted_Oregon_SRP.pdf
- ODOT. (2015a). *Oregon Department of Transportation*. Retrieved November 2015, from <http://www.oregon.gov/ODOT/Pages/index.aspx>
- ODOT. (2015b, November). *About Us*. Retrieved November 4, 2015, from http://www.oregon.gov/ODOT/Pages/about_us.aspx
- ODOT. (2015c, November). *Scenic Byways Programs' Proponents*. Retrieved November 4, 2015, from <http://www.oregon.gov/ODOT/HWY/SCENICBYWAYS/Pages/proponents.aspx>
- ODOT. (2015d). *September 2015 State Radio Project Monthly Report*. Retrieved from https://www.oregon.gov/ODOT/HWY/StateRadioProject/docs/MPR/2015-09_MPR_Full-Report-60.pdf
- ODOT. (2015e, November 18). *State Radio Project--Vision*. Retrieved November 18, 2015, from http://www.oregon.gov/ODOT/HWY/StateRadioProject/pages/about_us.aspx
- ODOT. (2015f, October). *State Radio Project (Key Facts)*. Retrieved November 18, 2015, from <http://www.oregon.gov/ODOT/HWY/StateRadioProject/Pages/index.aspx>
- ODOT. (2015g). *Oregon Railroads*. Retrieved June 30, 2016, from https://www.oregon.gov/ODOT/RAIL/docs/Maps_Drawings/OR_Rail_Map_Updated_2015_4_22_15.pdf
- ODOT. (2016). *State Radio Project Background*. Retrieved June 27, 2016, from <https://www.oregon.gov/ODOT/HWY/StateRadioProject/Pages/Background.aspx>
- ODOT SRP Program Management. (2015). *State Radio Project*. Monthly Dashboard Report, Oregon Department of Transportation. Retrieved August 22, 2016, from <http://www.oregon.gov/ODOT/HWY/StateRadioProject/pages/index.aspx>
- ODSL. (2011a, December). *Oregon Wetland Program Plan (2011-2016)*. Retrieved July 1, 2016, from https://www.epa.gov/sites/production/files/2015-10/documents/or_wpp.pdf
- ODSL. (2011b). *Wetlands of Conservation Concern*. Retrieved December 3, 2015, from http://www.oregon.gov/dsl/PERMITS/docs/wetland_cons_concern.pdf
- ODSL. (2012, March). *Oregon Wetland Monitoring & Assessment Strategy*. Retrieved December 1, 2015, from https://www.oregon.gov/dsl/WETLAND/docs/oregon_monitoring_assessment_strategy.pdf
- ODSL. (2015a). *Oregon's Removal-Fill Law*. Retrieved December 1, 2015, from <http://www.oregon.gov/dsl/PERMITS/pages/index.aspx>
- ODSL. (2015b). *Oregon Department of State Lands*. Retrieved November 2015, from <http://www.oregon.gov/dsl/pages/index.aspx>
- Office of Surface Mining Reclamation and Enforcement. (2015, November 20). *e-AMLIS, Abandoned Mine Land Inventory System*. Retrieved November 20, 2015, from <http://amlis.osmre.gov/Map.aspx>
- OHA. (2015a, November). *Drinking Water*. Retrieved November 2015, from Oregon Health Authority: <https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/index.aspx>
- OHA. (2015b, November). *333-061-0020 Definitions*. Retrieved November 2015, from Oregon Health Authority: <https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Rules/Documents/61-0020.pdf>

- OHA. (2015c, November). *Annual Compliance Reporting*. Retrieved November 2015, from Oregon Health Authority:
<https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Pages/acr.aspx>
- OHA. (2015d, November). *Consumer Confidence Reports*. Retrieved November 2015, from Oregon Health Authority:
<https://public.health.oregon.gov/HealthyEnvironments/DrinkingWater/Monitoring/Pages/ccr.aspx>
- O'Neil, T. A., & Johnson, D. H. (2001). *Oregon and Washington Wildlife Species and their Habitats*. Retrieved from <http://nwhi.org/inc/data/GISdata/docs/WHROW/chapter1.pdf>
- OPPA. (2015a, November). *Oregon Public Ports Association*. Retrieved November 2015, from Oregon Public Ports Association: <http://oregonports.com/index.html>
- OPPA. (2015b, November). *Oregon Public Ports Association*. Retrieved November 2015, from Oregon Ports- Directory: <http://oregonports.com/oregonports/directory.html>
- OPRD. (2015a). *Ocean Shore State Recreation Area*. Retrieved November 2015, from http://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=193
- OPRD. (2015b). *Molalla River State Park*. Retrieved November 2015, from http://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=78
- OPRD. (2015c). *Oregon State Parks: Find a Park - Heritage Areas and Sites*. Retrieved November 18, 2015, from http://oregonstateparks.org/index.cfm?do=visit.dsp_find
- OPRD. (2015d). *Oregon State Parks: Emigrant Springs State Heritage Area*. Retrieved November 18, 2015, from http://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=16
- OPRD. (2015e). *The Oregon State Park System Plan: A Strategic Outlook*. Retrieved November 18, 2015, from Oregon State Parks: <http://www.oregon.gov/oprd/Documents/Park-System-Plan-summary-20121231.pdf>
- OPRD. (2015f). *Oregon State Parks: Bates State Park Photos*. Retrieved November 18, 2015, from http://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPubs&parkId=109
- OPRD. (2016a). *Oregon Heritage: Historic Places*. Retrieved April 2016, from <http://www.oregon.gov/OPRD/HCD/HSTPLCS/Pages/index.aspx>
- OPRD. (2016b). *About Us*. Retrieved July 1, 2016, from http://www.oregon.gov/oprd/HCD/Pages/about_us.aspx
- OPRD. (2016c). *State Historic Preservation Office*. Retrieved June 30, 2016, from <http://www.oregon.gov/oprd/HCD/SHPO/Pages/index.aspx>
- ORBIC. (2010). *Oregon Natural Areas Plan*. Retrieved December 15, 2015, from <http://orbic.pdx.edu/documents/2010NAP.pdf>
- Oregon BCD. (2015). *Oregon Building Codes*. Retrieved November 2015, from http://www.bcd.oregon.gov/programs/online_codes.html
- Oregon Coastal Management Program. (2015). *Oregon's Coastal Zone*. Retrieved from http://www.oregon.gov/lcd/ocmp/pages/cstzone_intro.aspx
- Oregon Department of Agriculture (Plant Division). (2007). *Eurasian watermilfoil*. Retrieved June 29, 2016, from <http://library.state.or.us/repository/2010/201008181108513/index.pdf>
- Oregon Department of Aviation. (2008, July 7). *Oregon System Plan 2007 with Updates*. Retrieved June 30, 2016, from http://www.oregon.gov/aviation/Pages/docs/system_plan/2007_oregon_system_plan_details.aspx#Report

- Oregon Department of Aviation. (2015a). *Aviation*. Retrieved November 2015, from http://www.oregon.gov/aviation/Pages/About_Us_1.aspx
- Oregon Department of Aviation. (2015b). *Aviation, Programs Division*. Retrieved November 2015, from http://www.oregon.gov/aviation/Pages/Program_Division.aspx
- Oregon Department of Geology and Mineral Industries. (2009). *Oregon: A Geologic History*. Retrieved December 2015, from <http://www.oregongeology.org/sub/publications/IMS/ims-028/index.htm>
- Oregon Department of Geology and Mineral Industries. (2015a). *Generalized Geologic Map of Oregon*. Retrieved December 2015, from http://www.oregongeology.org/sub/publications/IMS/ims-028/sesqui-postcard_6x8.pdf
- Oregon Department of Geology and Mineral Industries. (2015b). *Earthquake Education*. Retrieved December 2015, from <http://www.oregongeology.org/sub/earthquakes/HistoricEQs.htm>
- Oregon Department of Geology and Mineral Industries. (2015c). *Earthquake Hazards in the Pacific Northwest*. Retrieved December 2015, from <http://www.oregongeology.org/sub/earthquakes/EQs.htm>
- Oregon Department of Geology and Mineral Industries. (2015d). *Mineral Land Regulation & Reclamation*. Retrieved November 20, 2015, from <http://www.oregongeology.org/mlrr/default.htm>
- Oregon Department of Geology and Mineral Industries. (2015e). *Earthquake Hazards in the Pacific Northwest*. Retrieved March 2015, from <http://www.oregongeology.org/sub/earthquakes/EQs.htm>
- Oregon Department of Geology and Mineral Industries. (2016). *Learn more about Oregon's geology*. Retrieved July 1, 2016, from <http://www.dogami.state.or.us/sub/learnmore/Cascades.HTM>
- Oregon Department of Land Conservation and Development. (2010). *Oregon's Statewide Planning Goals and Guidelines*. Retrieved November 2015, from <http://www.oregon.gov/LCD/Pages/goals.aspx>
- Oregon DEQ - Air Quality Planning. (2015, July). Retrieved November 17, 2015, from <http://www.deq.state.or.us/aq/forms/aqdatasum2014.pdf>
- Oregon DEQ. (1997). *Oregon Department of Environmental Quality Environmental Justice Policy*. Retrieved November 2015, from <http://www.deq.state.or.us/nwr/docs/1997DEQ-EJ-policy.pdf>
- Oregon DEQ. (2010, April). *National Pollutant Discharge Elimination System Memorandum of Agreement*. Retrieved November 2015, from Oregon Department of Environmental Quality: <http://www.deq.state.or.us/wq/pubs/moas/NPDESMOAEPA201004.pdf>
- Oregon DEQ. (2013a, January). *2011-2012 Solid Waste Management Program Information Update*. Retrieved November 2015, from Oregon Department of Environmental Quality: <http://www.deq.state.or.us/lq/pubs/docs/sw/LegReport2012.pdf>
- Oregon DEQ. (2013b). *Construction Stormwater Erosion and Sediment Control Manual*. Retrieved December 2015, from <http://www.deq.state.or.us/wq/wqpermit/docs/general/npdes1200c/ErosionSedimentControl.pdf>
- Oregon DEQ. (2015a, January). *Water Quality Permit Program*. Retrieved November 2015, from Oregon Department of Environmental Quality: <http://www.deq.state.or.us/wq/wqpermit/permits.htm>

- Oregon DEQ. (2015b, November). *Wastewater Operator Certification*. Retrieved November 2015, from Oregon Department of Environmental Quality:
<http://www.deq.state.or.us/wq/opcert/opcert.htm>
- Oregon DEQ. (2015c, November). *Wastewater System Operator Certification*. Retrieved November 2015, from Oregon Department of Environmental Quality:
http://www.deq.state.or.us/wq/opcert/docs/FAQ_OpCert.pdf
- Oregon DEQ. (2015d, November). *Land Quality*. Retrieved November 2015, from Oregon Department of Environmental Quality: <http://www.deq.state.or.us/lq/sw/permits.htm>
- Oregon DEQ. (2015e). *Section 401 Certification*. Retrieved December 7, 2015, from <http://www.deq.state.or.us/wq/sec401cert/faqs.htm>
- Oregon DEQ. (2015f). *Construction Stormwater General Permit*. Retrieved December 3, 2015, from <http://www.deq.state.or.us/wq/stormwater/stormwatergenpermit.htm>
- Oregon DEQ. (2015g, May). *Oregon Water Quality Index Summary Report Water Years 2005-2014*. Retrieved December 3, 2015, from <http://www.deq.state.or.us/lab/wqm/docs/wqiAnnualRep2014.pdf>
- Oregon DEQ. (2015h, January). *Groundwater Quality Protection in Oregon*. Retrieved December 7, 2015, from <http://www.deq.state.or.us/pubs/legislativepubs/2015/GoundwaterReport.pdf>
- Oregon DEQ. (2015i). *Oregon Department of Environmental Quality Environmental Justice*. Retrieved November 2015, from <http://www.deq.state.or.us/about/envjusticelaws.htm>
- Oregon DEQ. (2015j, April 16). *OAR Division 22 - Ambient Air Quality Standards and PSD Increments*. Retrieved November 18, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_202.html
- Oregon DEQ. (2015k, April 16). *OAR Division 218 - Oregon Title V Operating Permits*. Retrieved November 16, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_218.html
- Oregon DEQ. (2015l, April 16). *OAR Title 340, Division 210, Stationary Source Notification Requirements*. Retrieved November 16, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_210.html
- Oregon DEQ. (2015m, October 14). *OAR Division 254 - Rules for Indirect Sources*. Retrieved November 25, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_254.html
- Oregon DEQ. (2015n). *Oregon Department of Environmental Quality Chapter 340 Division 35*. Retrieved 09 28, 2015, from <http://www.nonoise.org/lawlib/states/oregon/oregon.htm>
- Oregon DEQ. (2015o). *Site Response Program*. Retrieved November 18, 2015, from <http://www.deq.state.or.us/lq/cu/response/superfund.htm>
- Oregon DEQ. (2015p). *Brownfields in Oregon*. Retrieved November 19, 2015, from <http://www.deq.state.or.us/lq/cu/brownfields/index.htm>
- Oregon DEQ. (2015q). *Voluntary Cleanup Program*. Retrieved November 19, 2015, from <http://www.deq.state.or.us/lq/cu/voluntarycu.htm>
- Oregon DEQ. (2015r). *St. Helens receives EPA grant for waterfront plan: DEQ provided environmental investigation oversight of redevelopment plan*. Retrieved November 19, 2015, from <http://www.deq.state.or.us/lq/pubs/docs/cu/EPAgrantStHelenssite.pdf>
- Oregon DEQ. (2015s, April 16). *Division 200, General Air Pollution Procedures and Definitions*. Retrieved November 16, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_200.html

- Oregon Economic & Community Development Department. (2015). *Oregon Coalition Brownfields Cleanup*. Retrieved November 19, 2015, from <http://www.deq.state.or.us/lq/pubs/docs/cu/ORCoalitionBrownfieldsCleanup.pdf>
- Oregon Explorer. (2015). *Facts about Crater Lake*. Retrieved December 4, 2015, from <http://oe.oregonexplorer.info/craterlake/facts.html>
- Oregon Health Authority. (2014). *Oregon Climate and Health Profile Report*. Retrieved July 1, 2016, from <https://public.health.oregon.gov/HealthyEnvironments/climatechange/Documents/oregon-climate-and-health-profile-report.pdf>
- Oregon Historic Trails Fund. (2012). *The Trails*. Retrieved November 18, 2015, from <http://www.oregonhistoricaltrailsfund.org/trails/>
- Oregon Historical Society. (2015). *Oregon Historical Society*. Retrieved November 2015, from <http://www.ohs.org/>
- Oregon Laws. (2013a). *Chapter 836.005 Definitions, Airport Hazards*. Retrieved November 2015, from https://www.oregonlegislature.gov/bills_laws/ors/ors836.html
- Oregon Laws. (2013b). *Oregon Laws, Chapter 836.535, Hazards to Air Navigation*. Retrieved November 2015, from <http://www.oregonlaws.org/ors/836.535>
- Oregon Laws. (2013c). *Volume 17, Utilities, Vehicle Code, Watercraft, Aviation, Constitutions, Title 62 Aviation, Chapters 835-838*. Retrieved November 2015, from <http://www.oregonlaws.org/ors/volume/17>
- Oregon Laws. (2015). *Oregon Laws*. Retrieved November 2015, from https://www.oregonlegislature.gov/bills_laws/Pages/Oregon-Laws.aspx
- Oregon Office of Emergency Management. (2015). *Oregon Office of Emergency Management*. Retrieved November 2015, from <http://www.oregon.gov/omd/oem/Pages/index.aspx>
- Oregon Public Health Division. (2015a). *Oregon State Health Profile*. Retrieved November 19, 2015, from <https://public.health.oregon.gov/About/Pages/HealthStatusIndicators.aspx>
- Oregon Public Health Division. (2015b). *Brownfield Initiative*. Retrieved November 19, 2015, from <http://public.health.oregon.gov/HealthyEnvironments/HealthyNeighborhoods/Brownfields/Pages/index.aspx>
- Oregon Public Health Division. (2015c). *Oregon Environmental Public Health Tracking*. Retrieved November 18, 2015, from <http://epht.oregon.gov/Index.aspx>
- Oregon Rapid Wetland Assessment Protocol. (2009). *Field F Data Form*. Retrieved June 28, 2016, from https://www.oregon.gov/dsl/WETLAND/docs/orwap_fieldf.pdf
- Oregon Revised Statutes. (2013). *Oregon Revised Statutes*. Retrieved November 2015, from https://www.oregonlegislature.gov/bills_laws/Pages/ORS.aspx
- Oregon Secretary of State. (2015a). *Department of Transportation, Highway Division - Division 32, Oregon Scenic Byways Program*. Retrieved November 16, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_700/oar_734/734_032.html
- Oregon Secretary of State. (2015b). *Oregon Blue Book: Oregon History*. Retrieved September 15, 2015, from <http://bluebook.state.or.us/cultural/history/history.htm>
- Oregon Secretary of State. (2015c). *State Symbols: Flag to Motto*. Retrieved November 2015, from <http://bluebook.state.or.us/kids/symbols/symbols02.htm>
- Oregon Secretary of State. (2015d). *Parks and Recreation Department: Division 40: Oregon Scenic Waterways*. Retrieved November 17, 2015, from http://arcweb.sos.state.or.us/pages/rules/oars_700/oar_736/736_040.html

- Oregon State Parks. (2015). *Home*. Retrieved November 18, 2015, from <http://oregonstateparks.org/>
- Oregon State Parks. (2016). *Find a Park*. Retrieved June 30, 2016, from http://oregonstateparks.org/index.cfm?do=visit.dsp_find
- Oregon Zoo. (2016). *Oregon Silverspot Butterfly*. Retrieved August 9, 2016, from <http://www.oregonzoo.org/conserve/fighting-extinction-pacific-northwest/oregon-silverspot-butterfly>
- Oregon.gov. (2015a). *State Forests: About*. Retrieved November 18, 2015, from <http://www.oregon.gov/ODF/Working/Pages/StateForests.aspx>
- Oregon.gov. (2015b). *Scenic Waterways Program*. Retrieved November 17, 2015, from <http://www.oregon.gov/oprd/RULES/pages/waterways.aspx>
- Oregon.gov. (2015c). *Scenic Byways: Scenic Byways Programs' Proponents*. Retrieved November 16, 2015, from http://www.oregon.gov/ODOT/HWY/SCENICBYWAYS/Pages/proponents.aspx#Oregon_State_Byways
- Oregon.gov. (2015d). *Scenic Byways: Scenic Byways & Tour Routes - A Driving Guide*. Retrieved November 16, 2015, from http://www.oregon.gov/ODOT/HWY/SCENICBYWAYS/Pages/driving_guide.aspx
- Oregon.gov. (2015e). *DLCD Planning for Climate Change*. Retrieved 2015, from http://www.oregon.gov/LCD/CLIMATECHANGE/pages/metropolitan_greenhouse_gas_reduction_targets.aspx
- Oregon.gov. (2015f). *Oregon Parks and Recreation Department: Oregon Heritage: State Historic Preservation Office*. Retrieved November 18, 2015, from <http://www.oregon.gov/oprd/HCD/SHPO/Pages/index.aspx>
- OSHA. (2002). *Occupational Safety & Health Administration We Can Help*. Retrieved from Hearing Conservation: <https://www.osha.gov/Publications/OSHA3074/osha3074.html>
- OSHA. (2003). *Fact Sheets on Natural Disaster Recovery: Flood Cleanup*. Retrieved December 2013, from https://www.osha.gov/OshDoc/data_Hurricane_Facts/Bulletin2.pdf
- OSHA. (2013). *OSHA Technical Manual - Noise*. Retrieved from https://www.osha.gov/dts/osta/otm/new_noise/index.pdf
- OSHA. (2015a). *Oregon State Plan*. Retrieved November 18, 2015, from <https://www.osha.gov/dcsp/osp/stateprogs/oregon.html>
- OSHA. (2015b). *Communication Towers*. Retrieved from <https://www.osha.gov/doc/topics/communicationtower/index.html>
- OSHA. (2015c). *Occupational Safety & Health Administration We Can Help*. (S. L. OSHA Directorate of Technical Support and Emergency Management, & U. Salt Lake City, Editors) Retrieved September 22, 2015, from Safety & Health Management System Tools: <https://www.osha.gov/SLTC/etools/safetyhealth/comp3.html#Safe Work Practices>
- OSHA. (2016a, March 28). *Regulations (Standards - 29 CFR)*. Retrieved from Occupational Safety & Health Administration: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9867
- OSHA. (2016b, May 29). *Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring*. Retrieved from https://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html

- OSHA. (2016c). *Restoring Communications Systems*. Retrieved February 16, 2016, from Infrastructure Repair and Restoration: <https://www.osha.gov/SLTC/etools/hurricane/communications.html>
- OWEB. (2011a). *Klamath Basin*. Retrieved December 4, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/klamath.aspx
- OWEB. (2011b). *Deschutes Basin*. Retrieved December 4, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/deschutes.aspx
- OWEB. (2011c). *Powder Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/powder.aspx
- OWEB. (2011d). *Willamette Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/willamette.aspx
- OWEB. (2011e). *Rogue Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/rogue.aspx
- OWEB. (2011f). *North Coast Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/north_coast.aspx
- OWEB. (2011g). *John Day Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/john_day.aspx
- OWEB. (2011h). *Lakes Basin*. Retrieved December 4, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/lakes_basin.aspx
- OWEB. (2011i). *South Coast Basin*. Retrieved December 3, 2015, from http://www.oregon.gov/OWEB/pages/BiennialReport_0911/south_coast.aspx
- Pacific Fishery Management Council. (2011). *Coastal Pelagic Species Fishery Management Plan*. Retrieved June 29, 2016, from http://www.westcoast.fisheries.noaa.gov/publications/fishery_management/cps_program/cps_fmp_as_amended_thru_a13_current.pdf
- Pacific Fishery Management Council. (2016a). *Pacific Coast Groundfish Fishery Management Plan*. Retrieved June 29, 2016, from http://www.pcouncil.org/wp-content/uploads/2016/03/GF_FMP_FINAL_Mar2016_Mar282016.pdf
- Pacific Fishery Management Council. (2016b, March). *Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species*. Retrieved June 2016, from Highly Migratory Species: <http://www.pcouncil.org/wp-content/uploads/2016/03/HMS-FMP-Mar16.pdf>
- Pacific Fishery Management Council. (2016c). *2016 Pacific Halibut Catch Sharing Plan for Area 2A*. Retrieved June 2016, from Pacific Halibut: http://www.pcouncil.org/wp-content/uploads/2016/01/Final_2016_PACIFIC_HALIBUT_CATCH_SHARING_PLAN_FOR_AREA_2A.pdf
- Pacific Fishery Management Council. (2016d). *Pacific Coast Salmon Fishery Management Plan*. Retrieved June 29, 2016, from http://www.pcouncil.org/wp-content/uploads/2016/03/FMP-through-A-19_Final.pdf
- Page, S. D. (2012, October 15). Timely Processing of Prevention of Significant Deterioration (PSD) Permits when EPA or a PSD-Delegated Air Agency Issues the Permit. Retrieved April 21, 2015, from <http://www.epa.gov/region7/air/nsr/nsrmemos/timely.pdf>
- Paleontology Portal. (2015). *Oregon, U.S.* Retrieved November 2015, from http://paleoportal.org/index.php?globalnav=time_space§ionnav=state&state_id=60
- Petrides, G. A. (1973). *Peterson Field Guides: Trees and Shrubs, 2nd edition*. Houghton Mifflin Company.

- Port of Astoria. (2015, November). *About the Port*. Retrieved November 2015, from The Port of Astoria: http://www.portofastoria.com/About_the_Port_of_Astoria.aspx
- Port of Brookings Harbor. (2016). *Welcome to Brookings Harbor*. Retrieved April 27, 2016, from Port of Brookings Harbor: <https://www.portofbrookingsharbor.com/>
- Port of Coos Bay. (2015a, November). *Navigation and Channel Data*. Retrieved November 2015, from Port of Coos Bay: <http://portofcoosbay.com/channel.htm>
- Port of Coos Bay. (2015b, November). *Terminals and Docks*. Retrieved November 2015, from Port of Coos Bay: <http://portofcoosbay.com/terminals.htm>
- Port of Coos Bay. (2015c, November). *Overview of Marine Cargo Diversification and Coos Bay Harbor Deep-Draft Navigation System Modification, Consultant Reports and Related Information 2002-2012*. Retrieved November 2015, from Port of Coos Bay: <http://portofcoosbay.com/packets2012/marinecargoreport2012.pdf>
- Port of Newport. (2015a, November). *Newport International Terminal*. Retrieved November 2015, from Port of Newport: <http://www.portofnewport.com/international-terminal/index.php>
- Port of Newport. (2015b, November). *International Terminal Shipping Facility*. Retrieved November 2015, from Port of Newport: <http://www.portofnewport.com/international-terminal-export-facility.php>
- Port of Portland. (2015a, November). *Facilities Map*. Retrieved November 2015, from Port of Portland: <http://www2.portofportland.com/Marine/FacilitiesMap>
- Port of Portland. (2015b, November). *North American Rail Connections*. Retrieved November 2015, from Port of Portland: http://cdn.portofportland.com/pdfs/Prp_US_Rail.pdf
- Port of Portland. (2015c, November). *Terminal 2*. Retrieved November 2015, from Port of Portland: [http://www2.portofportland.com/\(X\(1\)S\(s2ff3waatnvrbuviudemjwdg\)\)/Marine/Terminal2](http://www2.portofportland.com/(X(1)S(s2ff3waatnvrbuviudemjwdg))/Marine/Terminal2)
- Port of Portland. (2015d, November). *Terminal 4*. Retrieved November 2015, from Port of Portland: [http://www2.portofportland.com/\(X\(1\)S\(s2ff3waatnvrbuviudemjwdg\)\)/Marine/Terminal4](http://www2.portofportland.com/(X(1)S(s2ff3waatnvrbuviudemjwdg))/Marine/Terminal4)
- Portland International Airport. (2015a, November). *Portland international Airport (PDX) home page*. Retrieved November 4, 2015, from <http://www.pdx.com/PDX>
- Portland International Airport. (2015b, June). *June 2015 and Fiscal Year 2015 Statistics, Monthly Traffic Report*. Retrieved November 4, 2015, from Portland International Airport (PDX): <http://cdn.portofportland.com/pdfs/June2015webstats.pdf>
- Project25.org. (2015a, August 28). *P25 Phase1 FDMA System in Service (June 2015)*. Retrieved August 28, 2015, from http://www.Project25.org/images/stories/ptig/docs/P25_Phase_1_FDMA_Systems_REV_2_update_June_2015.pdf
- Project25.org. (2015b, August 28). *P25 Phase 1 TDMA System in Service June 2015*. Retrieved August 28, 2015, from http://www.project25.org/images/stories/ptig/docs/P25_Phase_2_TDMA_Systems_Updated_June_2015.pdf
- ProximityOne. (2015). *State Population Projections, Outlook 2030*. Retrieved March 2015, from <https://proximityone.wordpress.com/2013/12/19/state-population-projections-2030/>
- PSCR. (2015). *Location-Based Services R&D Roadmap*. Retrieved from <http://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1883.pdf>

- PUC. (2015a, November). *About Us*. Retrieved November 2015, from Public Service Commission: http://www.puc.state.or.us/Pages/about_us.aspx
- PUC. (2015b). *Electric*. Retrieved June 27, 2016, from http://www.puc.state.or.us/Pages/electric_gas/Electric.aspx
- PUC. (2015c, November). *Rate Regulated Water Utilities*. Retrieved November 2015, from Public Utility Commission: <http://apps.puc.state.or.us/edockets/utlist.asp?Electric=&Gas=&Telephone=&Industry=WTR+&Water=RR++++&submit2=Submit>
- PUC. (2015d). *Public Utility Commission*. Retrieved November 2015, from <http://www.puc.state.or.us/Pages/Index.aspx>
- PUC. (2015e, November). *Water Section*. Retrieved November 2015, from Public Utility Commission: <http://www.puc.state.or.us/Pages/water/indexII.aspx>
- PUC. (2015f, November). *Service Regulated Water Utilities*. Retrieved June 27, 2016, from Public Utility Commission: <http://apps.puc.state.or.us/edockets/utlist.asp?Electric=&Gas=&Telephone=&Industry=WTR+&Water=SERVIC&submit2=Submit>
- Purdue University. (2015). *Hydrologic Soil Groups*. Retrieved June 2015, from <https://engineering.purdue.edu/mapserve/LTHIA7/documentation/hsg.html>
- Purdue University Consumer Horticulture. (2006). *What is Loam?* Retrieved May 19, 2016, from <https://hort.purdue.edu/ext/loam.html>
- RadioReference.com. (2015a, November 18). *Portland County Public Safety 700 MHz P25*. Retrieved November 18, 2015, from <http://www.radioreference.com/apps/db/?sid=6830>
- RadioReference.com. (2015b, November 18). *SW 7 County Interoperability Public Safety Radio Partnership*. Retrieved November 18, 2015, from <http://www.radioreference.com/apps/db/?sid=5641>
- RadioReference.com. (2015c, November 18). *Justice Integrated Wireless Network (IWIN)*. Retrieved November 18, 2015, from <http://www.radioreference.com/apps/db/?sid=3509>
- RadioReference.com. (2015d, November 18). *Frontier Digital Network*. Retrieved November 18, 2015, from <http://www.radioreference.com/apps/db/?sid=7408>
- RadioReference.com. (2016). *Washington County Consolidated Communications Agency (WCCCA)*. Retrieved June 27, 2016, from <http://www.radioreference.com/apps/db/?sid=8211>
- Recreation.gov. (2016). *U.S. Army Corps of Engineers - Oregon Recreation Areas and Facilities*. Retrieved April 2016, from <http://www.recreation.gov/campgroundDirectoryListByAgencyID.do?contractCode=NRSO&agencyID=70902>
- Rogers, D. J., Olshansky, R., & Rogers, B. R. (2004). *Damage to Foundations From Expansive Soils*. Retrieved March 23, 2015, from http://web.mst.edu/~rogersda/expansive_soils/DAMAGE%20TO%20FOUNDATIONS%20FROM%20EXPANSIVE%20SOILS.pdf
- Ross, M. (1956, March). Architecture in Oregon, 1845-1895. *Oregon Historical Quarterly*, 57(1), 4-64.
- Ross, M. D. (1959). *A Century of Architecture in Oregon, 1859-1959*. Portland: Women's Architectural League of the Oregon Chapter of the American Institute of Architects.

- Sacramento County Airport System. (2015). *Sacramento County Airport System Noise Page*. Retrieved 6 10, 2015, from http://www.sacramento.aero/scas/environment/noise/noise_101/
- SCEC. (2015). *State Climate Extremes Committee*. (N. O. Administration, Producer) Retrieved 2015, from National Climatic Data Center: <http://www.ncdc.noaa.gov/extremes/scec/records>
- Smithsonian Institution. (2016). *Glossary -- Courtesy of the Department of Paleobiology, National Museum of Natural History, Washington, DC*. Retrieved May 2016, from <http://paleobiology.si.edu/geotime/main/glossary.html#T>
- Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, Jr., C. R., . . . Tyack, P. L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals*, 121. Retrieved April 2016, from http://sea-inc.net/assets/pdf/mmnoise_aquaticmammals.pdf
- State of Oregon. (2010, May). *IA 7 - Severe Weather*. Retrieved from http://www.oregon.gov/omd/oem/plans_train/docs/eop/eop_ia_7_severe_weather.pdf
- State of Oregon. (2013). *2013 ORS Volume 9*. Retrieved November 2015, from <http://www.oregonlaws.org/ors/358.920>
- State of Oregon. (2015a). *Oregon Natural Hazards Mitigation Plan*. Retrieved December 2015, from http://www.oregon.gov/LCD/HAZ/docs/2015ORNHMP/2015ORNHMPApproved/Approved_2015ORNHMP.pdf
- State of Oregon. (2015b). *Oregon Blue Book*. Salem: State of Oregon.
- Texas Parks and Wildlife. (1997). *Learn about Texas Birds*. Retrieved June 28, 2016, from http://tpwd.texas.gov/publications/pwdpubs/media/pwd_bk_p4000_0038.pdf
- The National Academies Press. (2012). *Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future*. Retrieved from Committee on Sea Level Rise in California, Oregon, and Washington: <http://www.nap.edu/read/13389/chapter/1#ii>
- The Nature Conservancy. (2015a). *Places We Protect: Oregon*. Retrieved November 17, 2015, from <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/oregon/placesweprotect/index.htm>
- The Nature Conservancy. (2015b). *Agate Desert Preserve*. Retrieved November 17, 2015, from <http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/oregon/placesweprotect/agate-desert.xml>
- The Oregon Historical Society. (2015). *Oregon Historical Quarterly*. Retrieved 2016, from <http://www.jstor.org/stable/10.5403/oregonhistq.116.issue-1>
- Thompson, W. (2015). *Surficial Geology Handbook for Southern Maine*. Retrieved July 2015, from http://www.maine.gov/dacf/mgs/explore/surficial/sghandbook/surficial_geology_handbook_for_southern_maine.pdf
- Thorson, T., Bryce, S., Lammers, D., Woods, A., Omernick, J., Kagan, J., . . . Comstock, J. (2003). *Ecoregions of Oregon*. Retrieved from https://archive.epa.gov/wed/ecoregions/web/html/or_eco.html
- Travel Oregon. (2015a). *Greater Portland*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/greater-portland/>

- Travel Oregon. (2015b). *Willamette Valley*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/willamette-valley/>
- Travel Oregon. (2015c). *Southern Oregon*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/southern-oregon/>
- Travel Oregon. (2015d). *Central Oregon*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/central-oregon/>
- Travel Oregon. (2015e). *Mt. Hood/The Gorge*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/mt-hood-the-gorge/>
- Travel Oregon. (2015f). *Eastern Region*. Retrieved November 2015, from <http://traveloregon.com/cities-regions/eastern-oregon/>
- TriMet. (2015a, November). *About TriMet*. Retrieved November 4, 2015, from <http://trimet.org/about/>
- TriMet. (2015b, November). *Rail System*. Retrieved November 4, 2015, from <http://trimet.org/maps/img/railsystem.png>
- TriMet. (2015c, September 18). *TriMet Service and Ridership Information*. Retrieved November 4, 2015, from <http://trimet.org/pdfs/publications/trimetridership.pdf>
- U.S. Bureau of Justice Statistics. (2011, July 26). *Census of State and Local Law Enforcement Agencies*. Retrieved from <http://www.bjs.gov/index.cfm?ty=pbdetail&iid=2216>
- U.S. Census Bureau. (2006). *Government Finance and Employment Classification Manual*. 2006_classification_manual. Retrieved July 2015, from http://www2.census.gov/govs/pubs/classification/2006_classification_manual.pdf
- U.S. Census Bureau. (2012). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas first sorted by state FIPS code, then sorted by UACE code. Retrieved June 2015, from http://www2.census.gov/geo/docs/reference/ua/ua_st_list_all.xls
- U.S. Census Bureau. (2015a). *QuickFacts - Oregon*. Retrieved April 20, 2016, from <http://www.census.gov/quickfacts/table/PST045215/41>
- U.S. Census Bureau. (2015aa). American Community Survey, 2012 1-Year Estimates, Table B01003: Total Population. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_12_1YR_B01003&prodType=table
- U.S. Census Bureau. (2015ab). American Community Survey, 2013 1-Year Estimates, Table DP05, Demographic and Housing Estimates. Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP05&prodType=table
- U.S. Census Bureau. (2015ac). American Community Survey, 2013 1-Year Estimates, Table S1701: Poverty Status in the Past 12 Months. Retrieved August 31, 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1701&prodType=table
- U.S. Census Bureau. (2015ad). American Community Survey, 2009-2013 5-Year Summary File, Table B03002, Hispanic or Latino Origin by Race. Retrieved April 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015ae). American Community Survey, 2009-2013 5-Year Summary File, Table B17021, Poverty Status of Individuals in the Past 12 Months by Living Arrangement. Retrieved April 2015, from <http://dataferrett.census.gov>

- U.S. Census Bureau. (2015af). American Community Survey, 2009-2013 5-Year Summary File, Table C17002, Ratio of Income to Poverty Level in the Past 12 Months. Retrieved May 2015, from <http://dataferrett.census.gov>
- U.S. Census Bureau. (2015b). *Annual Estimates of the Resident Population: April 1, 2010 to July 1, 2014*. Washington, D.C.: U.S. Census Bureau, Population Division.
- U.S. Census Bureau. (2015c, March 11). *Foreign Trade*. Retrieved July 2015, from United States Census Bureau: <http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/index.html>
- U.S. Census Bureau. (2015d). *Exhibit 4a: U.S. General Imports - U.S. Port of Unloading and Method of Transportation*. Retrieved June 26, 2016, from <http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/exh4a.html>
- U.S. Census Bureau. (2015e). *Exhibit 1a: U.S. Exports - Domestic and Foreign Merchandise*. Retrieved June 27, 2016, from <http://www.census.gov/foreign-trade/Press-Release/2013pr/12/ft920/exh1a.html>
- U.S. Census Bureau. (2015f, May 28). *U.S. Census Bureau*. Retrieved May 21, 2015, from State and County Quickfacts: <http://quickfacts.census.gov/qfd/states/41000.html>
- U.S. Census Bureau. (2015g). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved June 2015, from Other Census Urban Area Information - Maps, Shapefiles & References: <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2015h). *Population Estimates Program, 2010-2014 Data*. Retrieved March 2015, from <http://www.census.gov/popest/data/national/totals/2014/NST-EST2014-alldata.html>
- U.S. Census Bureau. (2015i). *2010 Census Summary File 1, Table GCT-PH1, Population, Housing Units, Area, and Density*. Retrieved June 2015, from http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_SF1_GCTPH1.US01PR&prodType=table
- U.S. Census Bureau. (2015j). *Resident Population of the 50 States, the District of Columbia, and Puerto Rico: Census 2000*. File tab02.xls. Retrieved March 2015, from <https://www.census.gov/population/www/cen2000/maps/respop.html>
- U.S. Census Bureau. (2015k). American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Retrieved April 2015, from <http://dataferrett.census.gov/>
- U.S. Census Bureau. (2015l). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Other Census Urban Area Information - Maps, Shapefiles & References. Retrieved June 2015, from <http://www.census.gov/geo/reference/ua/urban-rural-2010.html>
- U.S. Census Bureau. (2015m). Census 2000 Summary File 1 (SF 1), Table P001, Total Population. Retrieved July 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t>
- U.S. Census Bureau. (2015n). American Community Survey, 2009-2013 5-Year Estimates, Table DP05, Demographic and Housing Estimates. Retrieved August 2015, from <http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>
- U.S. Census Bureau. (2015o). *Small Area Income and Poverty Estimates (SAIPE), 2013*. Retrieved March 2015, from <http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html>
- U.S. Census Bureau. (2015p). *American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics*. (Obtained via Census Bureau online American

- FactFinder tool) Retrieved April 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table
- U.S. Census Bureau. (2015q). American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars). Retrieved April 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table
- U.S. Census Bureau. (2015r). *Small Area Income and Poverty Estimates (SAIPE), 2013*. Retrieved March 2015, from
<http://www.census.gov/did/www/saipe/data/statecounty/data/2013.html>
- U.S. Census Bureau. (2015s). American Community Survey, 2013 1-Year Estimates, Table DP02, Selected social characteristics. Retrieved April 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP02&prodType=table
- U.S. Census Bureau. (2015t). American Community Survey, 2013 1-Year Estimates, Table S1902, Mean Income in the Past 12 Months (in 2013 Inflation-Adjusted Dollars). Retrieved April 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_S1902&prodType=table
- U.S. Census Bureau. (2015u). 2009-2013 American Community Survey 5-Year Estimates, Table DP03: Selected economic characteristics. Retrieved April, July 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP03&prodType=table
- U.S. Census Bureau. (2015v). American Community Survey, 2013 1-year Estimates, Table DP03, Selected economic characteristics. Retrieved June 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP03&prodType=table
- U.S. Census Bureau. (2015w). *American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions*. 2013_ACSSubjectDefinitions. Retrieved April 2015, from
http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf
- U.S. Census Bureau. (2015x). American Community Survey, 2013 1-Year Estimates, Table DP04, Selected housing characteristics. Retrieved April 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_1YR_DP04&prodType=table
- U.S. Census Bureau. (2015y). American Community Survey, 2009-2013 5-year Estimates, Table DP04, Selected housing characteristics. Retrieved April, July 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_13_5YR_DP04&prodType=table
- U.S. Census Bureau. (2015z). 2012 Census of Governments: Finance – Surveys of State and Local Government Finances, Table LGF001. Retrieved June 2015, from
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=COG_2012_LGF001&prodType=table
- U.S. Census Bureau. (2016). *American Community Survey (ACS)*. Retrieved March 2016, from
<http://www.census.gov/programs-surveys/acs/>

- U.S. Coast Guard. (2007). *National Response Center*. Retrieved November 20, 2015, from <http://www.nrc.uscg.mil/FOIAFiles/CY07.xlsx>
- U.S. Coast Guard. (2015, December 31). *National Response Center (2015 Reports)*. Retrieved March 24, 2016, from <http://www.nrc.uscg.mil/FOIAFiles/CY15.xlsx>
- U.S. Department of Commerce. (2013a, February). *Metropolitan Statistical Areas of Oregon*. Retrieved November 4, 2015, from U.S. Census Bureau: http://www2.census.gov/geo/maps/metroarea/stcbsa_pg/Feb2013/cbsa2013_OR.pdf
- U.S. Department of Commerce. (2013b, February 21). *Department of Commerce Environmental Justice Strategy*. Retrieved July 2015, from http://open.commerce.gov/sites/default/files/DOC_Environmental_Justice_Strategy.pdf
- U.S. Department of Interior. (2008). *Navajo Reservoir RMP/FEA Appendix E Noise*. Retrieved 07 22, 2015, from <https://www.usbr.gov/uc/envdocs/ea/navajo/appdx-E.pdf>
- U.S. Fire Administration. (2015, June 11). *National Fire Department Census*. Retrieved from <http://apps.usfa.fema.gov/census-download/main/download>
- U.S. GPO. (2010, April 5). *Title 40 Code of Federal Regulations Part 93.153*. Retrieved July 20, 2015, from http://www.ecfr.gov/cgi-bin/text-idx?SID=2028b268447f0bf79b396678569dac85&mc=true&node=se40.20.93_1153&rgn=div8
- U.S. GPO. (2012). *Title 7 -- Agriculture (Chapter 104 -- Plant Protection)*. Retrieved June 28, 2016, from <https://www.gpo.gov/fdsys/pkg/USCODE-2011-title7/pdf/USCODE-2011-title7-chap104.pdf>
- U.S. Harbors. (2015). *U.S. Harbors - Oregon*. Retrieved April 2016, from <http://or.usharbors.com/>
- U.S. Navy. (2015, December). *Naval Weapons Systems Training Facility Boardman Environmental Impact Statement*. Retrieved June 30, 2016, from <http://nwstfboardmaneis.com/DocumentsandReferences/EISDocuments/FinalEnvironmentalImpactStatement.aspx>
- University of California, Hastings College of Law. (2010). *Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases, Fourth Edition*. Retrieved August 2015, from <http://gov.uchastings.edu/public-law/docs/ejreport-fourthedition1.pdf>
- University of Minnesota. (2001). *Soils and Landscapes of Minnesota*. Retrieved July 2015, from <http://www.extension.umn.edu/agriculture/tillage/soils-and-landscapes-of-minnesota/>
- University of Oregon. (2015a). *Introduction to Connley Caves Research*. Retrieved 2016, from http://pages.uoregon.edu/ftrock/connley_caves_description.html
- University of Oregon. (2015b, November). *The UO and Oregon—Together Forever*. Retrieved November 2015, from <https://uoregon.edu/our-history>
- University of Virginia Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file [USProjections_2020to2040_all_data_updated_noshapefile.zip](http://www.coopercenter.org/demographics/national-population-projections). Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- USACE - Portland. (2015, October). *2012 Nationwide Regional Permit Conditions Portland District*. Retrieved December 3, 2015, from http://www.nwp.usace.army.mil/Portals/24/docs/regulatory/nationwide/NWP_Regional_Permit_Conditions_Revised_Oct_2015.pdf

- USACE. (1997, July 1). *Planning and Guidance Letter #97-09: Scenic and Aesthetic Considerations*. Retrieved October 15, 2015, from <http://planning.usace.army.mil/toolbox/library/MemosandLetters/pgl97-09.pdf>
- USACE. (2010, May). *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0)*. Retrieved December 7, 2015, from ERDC/EL TR-10-3: http://www.oregon.gov/dsl/WETLAND/docs/west_mtns_sup.pdf
- USACE. (2014, April 2). *State of Oregon - NWPL Final Draft Ratings*. Retrieved December 2, 2015, from USACE, Cold Regions Research and Engineering Laboratory (CRREL): http://www.oregon.gov/dsl/PERMITS/docs/OR_2014v1.pdf
- USACE. (2015a, August). *Corps Lakes Gateway: Oregon*. Retrieved June 29, 2016, from <http://corpslakes.usace.army.mil/visitors/states-print.cfm?state=OR&Activity=All>
- USACE. (2015b, August). *Corps Lakes Gateway: Oregon*. Retrieved November 18, 2015, from <http://corpslakes.usace.army.mil/visitors/states.cfm?state=OR>
- USDA. (2011). *Introduction to Nelson's Checker-Mallow*. Retrieved from http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_042947.pdf
- USDA. (2015a). *Ecoregions of the United States*. Retrieved from <http://www.fs.fed.us/rm/ecoregions/products/map-ecoregions-united-states/>
- USDA. (2015b). *Nez Perce National Historic Trail*. Retrieved November 19, 2015, from <http://www.fs.usda.gov/detail/npnht/home/?cid=stelprdb5245289>
- USDA. (2015c). *Plant Pests and Diseases*. Retrieved from https://www.aphis.usda.gov/wps/portal/aphis/ourfocus/planthealth?1dmy&urile=wcm%3Apath%3a%2FAPHIS_Content_Library%2FSA_Our_Focus%2FSA_Plant_Health%2FSA_Domestic_Pests_And_Diseases
- USDA. (2016). *2015 State Agriculture Overview, Oregon*. Retrieved June 30, 2016, from https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=OREGON
- USEPA. (1973, 07 27). *EPA.gov*. Retrieved 08 05, 2015, from National Service Center for Environmental Publications - Impact Characterization of Noise: <http://nepis.epa.gov/Exe/ZyNET.exe/9101DPQN.TXT?ZyActionD=ZyDocument&Client=EPA&Index=Prior+to+1976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&F>
- USEPA. (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*. Washington, D.C.: EPA.
- USEPA. (1979, March 19). Notification to Federal Land Manager Under Section 165(d) of the Clean Air Act. Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/fdlndmgr.pdf>
- USEPA. (1992a, October 19). Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts, Environmental Protection Agency. Retrieved April 21, 2015, from <http://www.epa.gov/region7/air/nsr/nsrmemos/class1.pdf>
- USEPA. (1992b, October 19). *Clarification of Prevention of Significant Deterioration (PSD) Guidance for Modeling Class I Area Impacts, U.S. Environmental Protection Agency*. (J. S. Seitz, Ed.) Retrieved April 21, 2015, from <http://www.epa.gov/sites/production/files/2015-07/documents/class1.pdf>

- USEPA. (1995). *America's wetlands: Our vital link between land and water*. Retrieved April 21, 2015, from U.S. Environmental Protection Agency, EPA843-K-95-001:
<http://water.epa.gov/type/wetlands/fish.cfm>
- USEPA. (2006). *Watershed Assessment, Tracking & Environmental Results System*. Retrieved December 2015, from Oregon Assessment Data for 2012:
http://ofmpub.epa.gov/tmdl_waters10/attains_state.control?p_state=OR
- USEPA. (2010, March 24). *Revisions to the General Conformity Regulations*. Retrieved April 20, 2015, from <https://www.epa.gov/general-conformity/final-revisions-general-conformity-regulations>
- USEPA. (2011a, December 12). *CERCLA Overview*. Retrieved from EPA Superfund:
<http://www.epa.gov/superfund/policy/cercla.htm>
- USEPA. (2011b). *North American Terrestrial Ecoregions—Level III*. Retrieved August 10, 2016, from
ftp://ftp.epa.gov/wed/ecoregions/pubs/NA_TerrestrialEcoregionsLevel3_Final-2june11_CEC.pdf
- USEPA. (2012a, May). *List of 156 Mandatory Class I Federal Areas*. Retrieved April 20, 2015, from Visibility: <https://www.epa.gov/visibility/list-156-mandatory-class-i-federal-areas>
- USEPA. (2012b, July 16). *Noise Pollution*. Retrieved August 4, 2015, from
<http://www.epa.gov/air/noise.html>
- USEPA. (2012c). *Climate Change Indicators in the United States 2012*. Retrieved 2015, from Environmental Protection Agency:
<http://www.epa.gov/climatechange/pdfs/climateindicators-full-2012.pdf>
- USEPA. (2013a). *Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States*. Retrieved from
http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm
- USEPA. (2013b, August 13). *General Conformity*. Retrieved April 20, 2015, from
<https://www.epa.gov/general-conformity>
- USEPA. (2013c, August 29). *Guidance for Indian Tribes Seeking Class I Redesignation of Indian Country Pursuant to Section 164(c) of the Clean Air Act*. Retrieved April 20, 2015, from
<http://www.epa.gov/air/tribal/pdfs/GuidanceTribesClassIRedesignationCAA.pdf>
- USEPA. (2013d). *Cleanups in my Community*. Retrieved October 2013, from
<http://www2.epa.gov/cleanups/cleanups-my-community>
- USEPA. (2014a, October 28). *Who Has to Obtain a Title V Permit*. Retrieved April 20, 2015, from <https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit>
- USEPA. (2014b, October 28). *Who Has to Obtain a Title V Permit*. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/permits/obtain.html>
- USEPA. (2014c, October 21). *National Ambient Air Quality Standards (NAAQS)*. Retrieved April 20, 2015, from <http://www.epa.gov/air/criteria.html>
- USEPA. (2015a). *Basic Information about Estuaries*. Retrieved June 28, 2016, from
<https://www.epa.gov/nep/basic-information-about-estuaries#whatis>
- USEPA. (2015b, May). *Sole Source Aquifer Protection Program*. Retrieved July 2015, from
<http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/solesourceaquifer.cfm>
- USEPA. (2015c). *Vernal Pools*. Retrieved June 28, 2016, from
<https://www.epa.gov/wetlands/vernal-pools>

- USEPA. (2015d). *Environmental Justice*. Retrieved July 2015, from <http://www.epa.gov/compliance/environmentaljustice/index.html>
- USEPA. (2015e). *EJSCREEN: Environmental Justice Screening and Mapping Tool*. Retrieved July 2015, from <http://www2.epa.gov/ejscreen>
- USEPA. (2015f, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: <https://www.epa.gov/title-v-operating-permits>
- USEPA. (2015g, July 14). *Air Permit Programs*. Retrieved April 20, 2015, from Air Quality Planning and Standards: <http://www3.epa.gov/airquality/permjmp.html>
- USEPA. (2015h, April 21). *The Green Book Nonattainment Areas for Criteria Pollutants*. Retrieved April 21, 2015, from <http://www.epa.gov/airquality/greenbook/>
- USEPA. (2015i, July). *U.S. Greenhouse Gas Inventory Report 1990-2013*. Retrieved July 28, 2015, from Greenhouse Gas Emissions: <http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html#data>
- USEPA. (2015j, October 8). *Cleanups in my Community*. Retrieved November 19, 2015, from http://ofmpub.epa.gov/apex/cimc/f?p=cimc:73:::71:P71_WELSEARCH:OR|State|OR||true|true|true|true|true|-1|sites|N|basic
- USEPA. (2015k, October 8). *Cleanups in My Community List Results*. Retrieved November 19, 2015, from [https://ofmpub.epa.gov/apex/cimc/f?p=100:35:16611391141732:::35:P35_State_code,P35_ADV_QUERY:OR,\(\(SF_EI_HE_CODE='N'\)\)](https://ofmpub.epa.gov/apex/cimc/f?p=100:35:16611391141732:::35:P35_State_code,P35_ADV_QUERY:OR,((SF_EI_HE_CODE='N')))
- USEPA. (2015l, October 29). *2013 TRI Analysis: State - Oregon*. Retrieved November 19, 2015, from http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?pstate=OR&pyear=2013
- USEPA. (2015m, November 12). *Envirofacts - PCS-ICIS*. Retrieved November 19, 2015, from <http://www3.epa.gov/enviro/facts/pcs-icis/search.html>
- USEPA. (2015n, November 4). *Envirofacts Search Results*. Retrieved November 19, 2015, from http://iaspub.epa.gov/enviro/efsystemquery.multisystem?fac_search=primary_name&fac_value=&fac_search_type=Beginning+With&postal_code=&location_address=&add_search_type=Beginning+With&city_name=&county_name=&state_code=OR&TribalLand=0&TribeType=selectTribe
- USEPA. (2015o, June). *U.S. Greenhouse Gas Emissions*. Retrieved September 22, 2015, from <http://www3.epa.gov/climatechange/science/indicators/ghg/us-ghg-emissions.html>
- USEPA. (2015p, October 8). *Emissions & Generation Resource Integrated Database (eGRID) Summary Table 1*. Retrieved March 10, 2016, from <http://www.epa.gov/energy/egrid-2012-summary-tables>
- USEPA. (2015q, November 16). *Portland Harbor Superfund Site*. Retrieved November 19, 2015, from <http://yosemite.epa.gov/R10/CLEANUP.NSF/ph/Portland+Harbor+Superfund+Site>
- USEPA. (2015r, January). *Chesapeake Bay Glossary*. Retrieved July 15, 2015, from http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do?details=&glossaryName=Chesapeake%20Bay%20Glossary
- USEPA. (2015s). *Terms and Acronyms Search Page*. Retrieved from https://iaspub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do
- USEPA. (2015t, July 17). *Technology Transfer Network - Basic Information*. Retrieved July 17, 2015, from http://cfpub.epa.gov/oarweb/mkb/basic_information.cfm

- USEPA. (2015u, January 30). Designations. Retrieved April 20, 2015, from <http://www.epa.gov/airquality/greenbook/define.html>
- USEPA. (2015v, January). *Chesapeake Bay Glossary - YOY*. Retrieved August 10, 2016, from https://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/glossariesandkeywordlists/search.do;jsessionid=uu51VEyaNP3_-ZmCnm1Q2DAoXKTB22bwdtSjp-_kkAzhmzGKsY-p!-2003163538?details=&vocabName=Chesapeake%20Bay%20Glossary&filterTerm=YOY&filterMatc
- USEPA. (2015w, November 16). *Portland Harbor Superfund Site*. Retrieved November 19, 2015, from http://www3.epa.gov/region10/pdf/sites/portlandharbor/location_map.jpg
- USEPA. (2016a, February 21). *Ecoregions of North America*. Retrieved from Western Ecology Division: https://archive.epa.gov/wed/ecoregions/web/html/na_eco.html
- USEPA. (2016b). *Environmental Justice*. Retrieved March 2016, from <http://www3.epa.gov/environmentaljustice/>
- USEPA. (2016c). *Oregon State Implementation Plan for Air Quality*. Retrieved July 1, 2016, from <https://yosemite.epa.gov/R10/AIRPAGE.NSF/7594bda73086704a88256d7f00743067/0b108e94004620e888257c3600696da7>
- USEPA. (2016d, May 29). *Glossary of Climate Change Terms*. Retrieved from <https://www3.epa.gov/climatechange/glossary.html>
- USEPA. (2016e, May 19). *De Minimis Levels*. Retrieved from <https://www3.epa.gov/airquality/genconform/deminimis.html>
- USEPA. (2016f, May 18). *Hazardous Air Pollutants*. Retrieved May 25, 2016, from <https://www.epa.gov/haps>
- USFS. (1995). *Landscape Aesthetics: A Handbook for Scenery Management*. Retrieved from http://www.fs.fed.us/cdt/carrying_capacity/landscape_aesthetics_handbook_701_no_app_end.pdf
- USFS. (2008). *Oregon's Forest Resources, 2001-2005; Five-Year Forest Inventory and Analysis Report*. Retrieved November 2015, from http://www.fs.fed.us/pnw/rma/fia-topics/publications/documents/OR_pnw-gtr765a.pdf
- USFS. (2009a, Sept 30). *Chapter 90 Communications Site Management*. Retrieved Nov 16, 2015, from Forest Service Handbook 2709.11 - Special Uses Handbook: http://www.fs.fed.us/specialuses/documents/Comm_Use_Policy_2709.11_90.doc
- USFS. (2009b). *Soil-Disturbance Field Guide*. Retrieved September 2015, from <http://www.fs.fed.us/t-d/pubs/pdf/08191815.pdf>
- USFS. (2013, March 28). *Other Congressionally Designated Areas*. Retrieved November 18, 2015, from <http://www.fs.fed.us/recreation/programs/cda/special-areas.shtml>
- USFS. (2015a). *Siuslaw National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/siuslaw/home>
- USFS. (2015b). *Rogue River-Siskiyou National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/rogue-siskiyou/home>
- USFS. (2015c). *Willamette National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/willamette/home>
- USFS. (2015d). *Umpqua National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/umpqua/home>

- USFS. (2015e). *Fremont-Winema National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/fremont-winema/home>
- USFS. (2015f). *Deschutes National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/deschutes/home>
- USFS. (2015g). *Ochoco National Forest and Crooked River National Grassland*. Retrieved November 2015, from <http://www.fs.usda.gov/main/ochoco/home>
- USFS. (2015h). *Mt. Hood National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/mthood/home>
- USFS. (2015i). *Malheur National Forest*. Retrieved November 2015, from <http://www.fs.usda.gov/main/malheur/home>
- USFS. (2015j). *Bitterroot National Forest*. Retrieved August 2015, from <http://www.fs.usda.gov/main/bitterroot/home>
- USFS. (2015k). *Home*. Retrieved November 18, 2015, from <http://www.fs.fed.us>
- USFS. (2015l). *Deschutes National Forest Plans and Large Area Planning Documents*. Retrieved November 19, 2015, from http://www.fs.usda.gov/detail/deschutes/landmanagement/planning/?cid=fsbdev3_035906
- USFS. (2015m). *Hells Canyon National Recreation Area*. Retrieved November 18, 2015, from <http://www.fs.usda.gov/detail/wallowa-whitman/recreation/?cid=stelprdb5238987>
- USFS. (2015n). *Columbia River Gorge National Scenic Area*. Retrieved November 18, 2015, from <http://www.fs.usda.gov/main/crgnsa/about-forest>
- USFS. (2015o). *About the Forest: Ochoco National Forest*. Retrieved November 16, 2015, from <http://www.fs.usda.gov/main/ochoco/about-forest>
- USFS. (2016a). *Fire Effects Information System Glossary*. Retrieved June 2016, from <http://www.fs.fed.us/database/feis/glossary.html#SCATTER-HOARD>:
- USFS. (2016b). *Pacific Northwest Forest Areas*. Retrieved June 30, 2016, from http://www.fs.usda.gov/detail/r6/home/?cid=fsbdev2_026675#oregon
- USFS. (2016c). *Pacific Crest National Scenic Trail*. Retrieved July 1, 2016, from <http://www.fs.usda.gov/pct/>
- USFWS. (1984). *McDonald's Rock-Cress Recovery Plan (Arabis mcdonaldiana)*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/840228.pdf
- USFWS. (1985). *Determination that the Warner Sucker is a Threatened Species and Designation of its Critical Habitat*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr1025.pdf
- USFWS. (1991). *Recovery Plan Malheur Wire-Lettuce*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/910321.pdf
- USFWS. (1993, February 12). *Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Plant "Sidalcea nelsoniana" (Nelson's Checker-mallow)*. Retrieved June 30, 2016, from Federal Register: <https://ecos.fws.gov/docs/frdocs/1993/93-3353.pdf>
- USFWS. (1994). *Determination of endangered status for the Conservancy Fairy Shrimp, Longhorn Fairy Shrimp, and the Vernal Pool Tadpole Shrimp; and Threatened Status for the Vernal Pool Fairy Shrimp*. Retrieved from http://ecos.fws.gov/docs/federal_register/fr2692.pdf
- USFWS. (1995). *Recovery Plan for the Lahontan Cutthroat Trout*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/950130.pdf

- USFWS. (1996). *Water Howellia (Howellia aquatilis) Recovery Plan*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/960924.pdf
- USFWS. (1998a). *Recovery Plan for the Threatened and Rare Native Fishes of the Warner Basin and Alkali Subbasin*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/980427.pdf
- USFWS. (1998b). *Applegate's Milk-vetch (Astragalus applegatei) Recovery Plan*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/980410d.pdf
- USFWS. (2000a). *Final Rule to List the Short-tailed Albatross as Endangered in the United States*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2000-07-31/pdf/00-19223.pdf#page=1>
- USFWS. (2000b). *Revised Recovery Plan for MacFarlane's Four-O'clock (Mirabilis macfarlanei)*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/000630.pdf
- USFWS. (2002). *Recovery Plan Howell's Spectacular Thelypody*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/020603.pdf
- USFWS. (2003). *Recovery Plan Rough Popcornflower*. Retrieved December 2015, from https://ecos.fws.gov/docs/recovery_plan/030925a.pdf
- USFWS. (2006a). *Critical Habitat for Fender's Blue Butterfly, Kincaid's Lupine, and Willamette Daisy*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2006-10-31/pdf/06-8809.pdf#page=1>
- USFWS. (2006b, October 31). *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Fender's blue butterfly, Kincaid's lupine, and Willamette daisy*. Retrieved June 30, 2016, from <https://www.gpo.gov/fdsys/pkg/FR-2006-10-31/pdf/06-8809.pdf#page=2>
- USFWS. (2006c). *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*. Retrieved from https://ecos.fws.gov/docs/recovery_plan/060614.pdf
- USFWS. (2007a). *5 Year Review Shortnose Sucker*. Retrieved from <http://www.fws.gov/cno/es/SNS5YR071007.pdf>
- USFWS. (2007b). *Vernal Pool Fairy Shrimp (Branchinecta lynchi) 5-Year Review: Summary and Evaluation*. Retrieved from http://ecos.fws.gov/docs/five_year_review/doc1150.pdf
- USFWS. (2007c). *Recovery Plan for Silene Spaldingii (Spalding's Catchfly)*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/071012.pdf
- USFWS. (2007d, December). *Greene's tuctoria (Tuctoria greenei) 5-Year Review: Summary and Evaluation*. Retrieved June 2016, from Sacramento Fish and Wildlife Office: https://ecos.fws.gov/docs/five_year_review/doc1867.pdf
- USFWS. (2008). *Loggerhead Sea Turtle Recovery Plan for the Northwest Atlantic Ocean Population*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/090116.pdf
- USFWS. (2009, January). *Chamaescye hooveri (Hoover's Spurge) 5-Year Review: Summary and Evaluation*. Retrieved 2016 June, from Sacramento Fish and Wildlife Office: https://ecos.fws.gov/docs/five_year_review/doc2387.pdf
- USFWS. (2010a). *Critical Habitat for Bull Trout*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2010-10-18/pdf/2010-25028.pdf#page=2>
- USFWS. (2010b). *Recovery Plan for the Prairie Species of Western Oregon and Southwestern Washington*. Retrieved June 2016, from http://fpdss.fws.gov/docs/recovery_plan/100629.pdf
- USFWS. (2010c). *Species Account Slender Orcutt Grass, Orcuttia tenuis*. Retrieved June 30, 2016, from

- http://www.fws.gov/sacramento/es_species/Accounts/Plants/Documents/slender_Orcutt_grass.rtf
- USFWS. (2011a). *Revised Critical Habitat for the Marbled Murrelet*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2011-10-05/pdf/2011-25583.pdf>
- USFWS. (2011b). *Oregon Silverspot Butterfly Species Profile*. Retrieved from http://www.fws.gov/arcata/es/inverts/orSS/ss_bfly.html
- USFWS. (2011c). *Species Fact Sheet: Gentner's Fritillary (Fritillaria gentneri)*. Retrieved from <http://www.fws.gov/oregonfwo/Species/Data/GentnersFritillary/>
- USFWS. (2012a). *Designation of Revised Critical Habitat for the Northern Spotted Owl; Final Rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2012-12-04/pdf/2012-28714.pdf>
- USFWS. (2012b). *Critical Habitat for Western Snowy Plover*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2012-06-19/pdf/2012-13886.pdf>
- USFWS. (2012c). *Designation of Critical Habitat for Lost River Sucker and Shortnose Sucker*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2012-12-11/pdf/2012-29332.pdf>
- USFWS. (2012d). *Recovery Plan for Rogue and Illinois Valley Vernal Pool and Wet Meadow Ecosystems*. Retrieved from http://ecos.fws.gov/docs/recovery_plan/Rogue&Illinois%20Valley%20Final%20Recovery%20Plan%20031913.pdf
- USFWS. (2013a). *Canada Lynx Fact Sheet*. Retrieved from http://www.fws.gov/mountain-prairie/species/mammals/lynx/CandaLynxFactSheet_091613.pdf
- USFWS. (2013b). *Critical Habitat for Streaked Horned Lark and Taylor's Checkerspot Butterfly*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2013-10-03/pdf/2013-23552.pdf>
- USFWS. (2013c). *Borax Lake Chub Fact Sheet*. Retrieved June 29, 2016, from <http://www.fws.gov/oregonfwo/Species/Data/BoraxLakeChub/>
- USFWS. (2013d). *Foskett Speckled Dace Fact Sheet*. Retrieved June 29, 2016, from <http://www.fws.gov/oregonfwo/Species/Data/FoskettSpeckledDace/>
- USFWS. (2013e, May 31). *Bear Valley National Wildlife Refuge: About the Refuge*. Retrieved November 16, 2015, from http://www.fws.gov/refuge/Bear_Valley/about.html
- USFWS. (2013f). Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2013-08-29/pdf/2013-20985.pdf>
- USFWS. (2013g, November 6). *Prairie Species of Western Oregon and Southwestern Washington*. Retrieved June 2016, from Oregon Fish and Wildlife Office: <https://www.fws.gov/oregonfwo/Species/PrairieSpecies/>
- USFWS. (2014a). *Candidate Species - Section 4 of the Endangered Species Act*. Retrieved from https://www.fws.gov/endangered/esa-library/pdf/candidate_species.pdf
- USFWS. (2014b). *Western Snowy Plover Species Profile*. Retrieved from <http://www.fws.gov/arcata/es/birds/WSP/plover.html>
- USFWS. (2014c). *Oregon Spotted Frog Fact Sheet*. Retrieved from http://www.fws.gov/wafwo/species/osf/OSF%20Fact%20Sheet_Final.pdf
- USFWS. (2014d). *Western Yellow-billed Cuckoo Factsheet*. Retrieved from <https://www.fws.gov/sacramento/outreach/Public-Advisories/WesternYellow-BilledCuckoo/docs/WYBC-factsheet-southwestlearning.pdf>
- USFWS. (2014e). *Revised Draft Recovery Plan for the Coterminous United States Population of Bull Trout*. Retrieved from

- http://www.fws.gov/oregonfwo/documents/RecoveryPlans/Bull_Trout_RevisedDraftRP.pdf
- USFWS. (2014f). *Oregon Spotted Frog*. Retrieved from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489458>
- USFWS. (2014g). *National Wetlands Inventory website*. Retrieved May 15, 2015, from <http://www.fws.gov/wetlands/>
- USFWS. (2015a, January 26). *Wetlands Mapper Legend Categories*. Retrieved April 20, 2015, from National Wetland Inventory: <http://www.fws.gov/wetlands/Data/Mapper-Wetlands-Legend.html>
- USFWS. (2015aa). *Species Profile for Lost River Sucker (Deltistes luxatus)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E052
- USFWS. (2015ab). *Species Profile for Shortnose Sucker (Chasmistes brevirostris)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E055
- USFWS. (2015ac). *Species Profile for Steelhead Trout*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E08D
- USFWS. (2015ad). *Species Profile for Warner Sucker (Catostomus warnerensis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E057
- USFWS. (2015ae). *Leatherback Sea Turtle Fact Sheet*. Retrieved June 29, 2016, from <http://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/PDF/Leatherback-Sea-Turtle.pdf>
- USFWS. (2015af). *Species Profile for Leatherback Sea Turtle (Dermochelys coriacea)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00F>
- USFWS. (2015ag, October 15). *About: Mission*. Retrieved October 23, 2015, from <http://www.fws.gov/refuges/about/mission.html>
- USFWS. (2015ah). *Species Profile for Loggerhead Sea Turtle (Caretta caretta)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=C00U>
- USFWS. (2015ai). *Species Profile for Olive Ridley Sea Turtle (Lepidochelys olivacea)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=C00V
- USFWS. (2015aj). *Species Profile for Oregon Spotted Frog (Rana pretiosa)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=D02A
- USFWS. (2015ak). *Fender's Blue Butterfly*. Retrieved from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489429>
- USFWS. (2015al). *Species Profile for Fender's Blue Butterfly (Icaricia icarioides fenderi)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=I0IS
- USFWS. (2015am). *Species Profile for Oregon Silverspot Butterfly (Speyeria zerene hippolyta)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=I01A
- USFWS. (2015an). *Taylor's Checkerspot Butterfly*. Retrieved from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489449>
- USFWS. (2015ao). *Species Profile for Taylor's Checkerspot (Euphydryas editha taylori)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=I0T6#crithab
- USFWS. (2015ap). *Taylor's Checkerspot Butterfly Fact Sheet*. Retrieved from http://www.fws.gov/wafwo/species/Fact%20sheets/TaylorsCheckerspot_factsheet.pdf

- USFWS. (2015aq). *Species Profile for Vernal Pool Fairy Shrimp (Branchinecta lynchi)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=K03G
- USFWS. (2015ar, February 12). *Species Fact Sheet: Bradley's desert parsley (Lomatium bradshawii)*. Retrieved June 2016, from Oregon Fish & Wildlife Office: <https://www.fws.gov/oregonfwo/species/data/bradshawsLomatium/>
- USFWS. (2015as). *Species Profile for Bradshaw's Desert-Parsley (Lomatium bradshawii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q1YN
- USFWS. (2015at). *Species Profile for Cook's Lomatium (Lomatium cookii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q356
- USFWS. (2015au). *Species Fact Sheet for Golden Paintbrush*. Retrieved from http://www.fws.gov/wafwo/species/Fact%20sheets/GPaintbrush_factsheet.pdf
- USFWS. (2015av). *Species Profile for Howell's Spectacular Thelypody (Thelypodium howellii spectabilis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q2K9
- USFWS. (2015aw, February 12). *Kincaid's Lupine*. (P. Camp, & J. Gamon, Editors) Retrieved August 4, 2016, from <https://www.fws.gov/oregonfwo/species/data/KincaidsLupine/default.asp>
- USFWS. (2015ax). *Species Profile for Kincaid's Lupine (Lupinus sulphureus ssp. kincaidii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q35E
- USFWS. (2015ay). *Species Profile for Large-Flowered Woolly Meadowfoam (Limnanthes floccosa ssp. grandiflora)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=Q2CL
- USFWS. (2015az). *Species Profile for Malheur Wire-Lettuce (Stephanomeria malheurensis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q221
- USFWS. (2015b, January 26). *Data Limitations, Exclusions and Precautions*. Retrieved May 11, 2015, from <http://www.fws.gov/wetlands/Data/Limitations.html>
- USFWS. (2015ba). *Species Profile for Rough Popcornflower (Plagiobothrys hirtus)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q1HU
- USFWS. (2015bb). *Species Profile for Spalding's Catchfly (Silene spaldingii)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=Q1P9
- USFWS. (2015bc). *Species Profile for Water Howellia (Howellia aquatilis)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?sPCODE=Q2RM
- USFWS. (2015bd). *Species Profile for Willamette Daisy (Erigeron decumbens var.)*. Retrieved from http://fpdss.fws.gov/tess_public/profile/speciesProfile.action?sPCODE=Q2TF
- USFWS. (2015c). *Threatened and Endangered Species in Oregon*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=OR&status=listed
- USFWS. (2015d). *Candidate Species in Oregon*. Retrieved from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=OR&status=candidate
- USFWS. (2015e). *Critical Habitat Report-Oregon*. Retrieved from <http://ecos.fws.gov/ecp/report/table/critical-habitat.html>

- USFWS. (2015f). *Listed species believed to or known to occur in Oregon*. Retrieved June 29, 2016, from http://ecos.fws.gov/tess_public/reports/species-listed-by-state-report?state=OR&status=listed
- USFWS. (2015g). *Reclassifying the Columbian White-tailed Deer Proposed Rule*. Retrieved from <https://www.gpo.gov/fdsys/pkg/FR-2015-10-08/pdf/2015-25260.pdf>
- USFWS. (2015h). *Species Profile for Columbian White-tailed Deer (Odocoileus virginianus leucurus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=A002
- USFWS. (2015i). *Species Profile for Gray Wolf*. Retrieved June 29, 2016, from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=A00D#crithab
- USFWS. (2015j). *Fact Sheet for the Gray Wolf*. Retrieved from <http://www.fws.gov/wafwo/species/Fact%20sheets/Gray%20wolf%20final.pdf>
- USFWS. (2015k). *Species Profile for Marbled Murrelet (Brachyramphus marmoratus)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=B08C
- USFWS. (2015l). *Species Profile for Northern Spotted Owl*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B08B
- USFWS. (2015m). *Species Profile for Short-tailed Albatross*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B00Y
- USFWS. (2015n). *Streaked Horned Lark*. Retrieved June 29, 2016, from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489450>
- USFWS. (2015o). *Species Profile for Streaked Horned Lark*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B0B3
- USFWS. (2015p). *Species Profile for Snowy Plover*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=B07C
- USFWS. (2015q). *Species Profile for Yellow-billed Cuckoo (Coccyzus americanus)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B06R>
- USFWS. (2015r). *Species Profile for Borax Lake Chub (Gila boraxobius)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E027
- USFWS. (2015s). *Species Profile for Bull Trout (Salvelinus confluentus)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E065#crithab
- USFWS. (2015t). *Species Profile for Chinook Salmon*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E06D
- USFWS. (2015u). *Species Profile for Chum Salmon (Oncorhynchus keta)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E09Q&ftb_embed=true
- USFWS. (2015v). *Species profile for Foskett Speckled Dace (Rhinichthys osculus ssp.)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=E03D
- USFWS. (2015w). *Hutton Tui Chub*. Retrieved from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489439>
- USFWS. (2015x). *Species Profile for Hutton Tui Chub (Gila bicolor ssp.)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=E02S
- USFWS. (2015y). *Species profile for Lahontan Cutthroat Trout (Oncorhynchus clarkii henshawi)*. Retrieved from <http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E00Y>

- USFWS. (2015z). *Lost River Sucker*. Retrieved from <http://www.fws.gov/oregonfwo/articles.cfm?id=149489443>
- USFWS. (2016a). *U.S. Counties within Oregon in which the Loggerhead sea turtle, North Pacific Ocean DPS is known to or is believed to occur*. Retrieved June 29, 2016, from http://ecos.fws.gov/tess_public/profile/countiesByState?entityId=9941&state=Oregon
- USFWS. (2016b). *Species Profile for Greene's Tuctoria (Tuctoria greenei)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q23K
- USFWS. (2016c). *Species Profile for Hoover's Spurge (Chamaesyce hooveri)*. Retrieved from https://ecos.fws.gov/tess_public/profile/speciesProfile.action?spcode=Q0E9
- USFWS. (2016d). *Species Profile for Macfarlane's Four-O'clock (Mirabilis macfarlanei)*. Retrieved from http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q1ZF#crithab
- USFWS. (2016e). *U.S. Counties within Oregon in which the Slender Orcutt grass is known to or believed to occur*. Retrieved June 2016, from https://ecos.fws.gov/tess_public/profile/countiesByState?entityId=583&state=Oregon
- USFWS. (2016f). *Refuge Locator Map -- Oregon*. Retrieved June 29, 2016, from <https://www.fws.gov/refuges/refugelocatormaps/Oregon.html>
- USFWS. (2016g). *Species Profile for Golden Paintbrush (Castilleja levisecta)*. Retrieved June 2016, from ECOS: Environmental Conservation Online System: http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q26U
- USFWS. (2016h). *U.S. Counties within Oregon in which the Golden Paintbrush is known to or is believed to occur*. Retrieved from Species Profile for Golden Paintbrush (Castilleja levisecta): http://ecos.fws.gov/tess_public/profile/countiesByState?entityId=899&state=Oregon
- USFWS. (2016i). *U.S. Counties within Oregon in which the Greene's tuctoria is known to or is believed to occur*. Retrieved June 2016, from Species Profile for Greene's tuctoria (Tuctoria geenei): http://ecos.fws.gov/tess_public/profile/countiesByState?entityId=858&state=Oregon
- USFWS. (2016j). *McDonald's rock-cress (Arabis macdonaldiana)*. Retrieved 6 30, 2016, from U.S. Fish and Wildlife Service: http://ecos.fws.gov/tess_public/profile/speciesProfile?spcode=Q1SX
- USFWS. (2016k, June 30). *U.S. Counties within Oregon in which the McDonald's rock-cress, is known to or is believed to occur*:. Retrieved from FWS: http://ecos.fws.gov/tess_public/profile/countiesByState?entityId=629&state=Oregon
- USFWS. (2016l). *U.S. Counties within Oregon in which the Nelson's checker-mallow is known to or is believed to occur*:. Retrieved June 30, 2016, from Species Profile for Nelson's checker-mallow (Sidalcea nelsoniana): http://ecos.fws.gov/tess_public/profile/countiesByState?entityId=828&state=Oregon
- USGCRP. (2014a). *National Climate Assessment: Northwest*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/northwest>
- USGCRP. (2014b). *U.S. Global Change Research Program: Precipitation Change*. Retrieved from National Climate Assessment: <http://nca2014.globalchange.gov/report/our-changing-climate/precipitation-change>
- USGCRP. (2014c). *National Climate Assessment: Coastal Zone Development and Ecosystems*. Retrieved from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/regions/coasts#narrative-page-16832>

- USGCRP. (2014d). *National Climate Assessment: Changes in Storms*. Retrieved July 28, 2015, from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/our-changing-climate/changes-storms>
- USGCRP. (2014e). *National Climate Assessment: Frost Free Season*. Retrieved November 20, 2015, from U.S. Global Change Research Program: <http://nca2014.globalchange.gov/report/our-changing-climate/frost-free-season>
- USGS. (1994a). *Ground Water Atlas of the United States, Idaho, Oregon, Washington HA 730-H*. Retrieved December 2015, from http://pubs.usgs.gov/ha/ha730/ch_h/H-text1.html
- USGS. (1994b). *Ground Water Atlas of the United States, HA 730-H*. Retrieved November 2015, from U.S. Geological Survey: http://pubs.usgs.gov/ha/ha730/ch_h/index.html
- USGS. (1999). *How Ground Water Occurs*. Retrieved February 12, 2013, from U.S. Geological Survey General Interest Publication: http://pubs.usgs.gov/gip/gw/how_a.html
- USGS. (2000). *Land Subsidence in the United States (Fact Sheet 165-00)*. Retrieved September 2013, from <http://water.usgs.gov/ogw/pubs/fs00165/SubsidenceFS.v7.PDF>
- USGS. (2003a). *National Landslide Hazards Mitigation Strategy – A Framework for Loss Reduction*. Retrieved September 2013, from <http://pubs.usgs.gov/circ/c1244/c1244.pdf>
- USGS. (2003b). *Federal Lands and Indian Reservations*. Retrieved June 30, 2016, from http://nationalmap.gov/small_scale/printable/images/pdf/fedlands/OR.pdf
- USGS. (2010). *What is "Peak Acceleration" or "Peak Ground Acceleration" (PGA)?* Retrieved April 2015, from <http://geohazards.usgs.gov/deaggint/2002/documentation/parm.php>
- USGS. (2011, August). *National Gap Analysis Program, Land Cover Data Portal*. (U.S. Geological Survey, Gap Analysis Program (GAP)) Retrieved April 22, 2014, from National Land Cover, Version 2: <http://gapanalysis.usgs.gov/gaplandcover/data/>
- USGS. (2012a). *Earthquake Glossary - Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/glossary/?term=earthquake>
- USGS. (2012b). *Pacific Northwest Pseudokarst Aquifers*. Retrieved December 2015, from <http://water.usgs.gov/ogw/karst/aquifers/pacificnw/index>
- USGS. (2012c, December). *The USGS Land Cover Institute*. Retrieved August 2015, from <http://landcover.usgs.gov/classes.php/>
- USGS. (2012d, November). *Gap Analysis Program (GAP)*. Retrieved from Protected Areas Database of the United States (PADUS), version 1.3 Fee: <http://gapanalysis.usgs.gov/padus/>
- USGS. (2012e, November). *National Gap Analysis Program, Protected Areas Data Portal*. (U.S. Geological Survey, Gap Analysis Program (GAP)) Retrieved April 22, 2014, from Protected Areas Database of the United States (PADUS), version 1.3: <http://gapanalysis.usgs.gov/padus/>
- USGS. (2013a). *Land Subsidence from Ground-water Pumping*. Retrieved September 2013, from <http://geochange.er.usgs.gov/sw/changes/anthropogenic/subside/>
- USGS. (2013b, January 10). *Physical Description of Upper Klamath Lake*. Retrieved December 4, 2015, from <http://pubs.usgs.gov/sir/2006/5209/section4.html>
- USGS. (2013c). *Glossary of Glacier Terminology*. Retrieved August 2015, from <http://pubs.usgs.gov/of/2004/1216/text.html#tz>
- USGS. (2013d, November 21). *Mount Mazama and Crater Lake: Growth and Destruction of a Cascade Volcano*. Retrieved January 28, 2016, from <http://pubs.usgs.gov/fs/2002/fs09202/>

- USGS. (2014a). *Geologic Provinces of the United States: Basin and Range Province*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/province/basinrange.html>
- USGS. (2014b). *Pacific Province*. Retrieved June 23, 2016, from <http://geomaps.wr.usgs.gov/parks/province/pacifmt.html>
- USGS. (2014c). *Geologic Provinces of the United States: Rocky Mountains*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/province/rockymtn.html>
- USGS. (2014d). *Oregon Seismicity Map - 1973 to March 2012*. Retrieved December 2015, from <http://earthquake.usgs.gov/earthquakes/states/oregon/seismicity.php>
- USGS. (2014e). *Understanding Plate Motions*. Retrieved November 2015, from <http://pubs.usgs.gov/gip/dynamic/understanding.html>
- USGS. (2014f, November). *Water Resources of the United States*. Retrieved July 2015, from <http://www.usgs.gov/water/>
- USGS. (2014g). *National Atlas of the United States*. Retrieved September 2015, from http://nationalmap.gov/small_scale/printable/fedlands.html
- USGS. (2014h). *Measuring the Size of an Earthquake*. Retrieved July 2015, from <http://earthquake.usgs.gov/learn/topics/measure.php>
- USGS. (2014i). *Landslide Overview Map of the Conterminous United States*. Retrieved June 2015, from <http://landslides.usgs.gov/hazards/nationalmap/>
- USGS. (2015a, September 8). *Geographic Names Information System (GNIS)*. Retrieved September 8, 2015, from <http://geonames.usgs.gov/apex/f?p=136:1:2933318154716>
- USGS. (2015b). *Structural Geology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?thcode=2&code=1117>
- USGS. (2015c). *Geologic Glossary*. Retrieved October 2015, from <http://geomaps.wr.usgs.gov/parks/misc/glossarya.html>
- USGS. (2015d). *Paleontology*. Retrieved July 2015, from <http://www.usgs.gov/science/science.php?term=861>
- USGS. (2015e). *Geologic Processes*. Retrieved Nov 16, 2015, from <http://www.usgs.gov/science/science.php?term=1145>
- USGS. (2015f). *Igneous and metamorphic-rock aquifers*. Retrieved December 7, 2015, from <https://water.usgs.gov/ogw/aquiferbasics/volcan.html>
- USGS. (2015g, April 14). *Aquifer Basics: Sand and Gravel Aquifers of Alluvial and Glacial Origin*. Retrieved July 2015, from <http://water.usgs.gov/ogw/aquiferbasics/sandgravel.html>
- USGS. (2015h). *Water Science Glossary of Terms*. Retrieved June 2015, from <http://water.usgs.gov/edu/dictionary.html#B>
- USGS. (2016a). *Mineral Commodity Summaries for 2015*. Retrieved April 2016, from <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>
- USGS. (2016b). *Facts about Crater Lake*. Retrieved July 1, 2016, from <http://oe.oregonexplorer.info/craterlake/facts.html>
- USGS. (2016c, January 28). *Mineral Commodity Summaries 2016*. Retrieved April 14, 2016, from <http://minerals.usgs.gov/minerals/pubs/mcs/2016/mcs2016.pdf>
- USGS. (2016d, February 10). *Explanations for the National Water Conditions*. Retrieved from Water Resources of the United States: http://water.usgs.gov/nwc/explain_data.html
- UVA Weldon Cooper Center. (2015). *University of Virginia Weldon Cooper Center for Public Service, National Population Projections, 2020-2040*. Projections for the 50 States and D.C., one-click download of all files, file

- USProjections_2020to2040_all_data_udpated_noshapefile.zip. Retrieved March 2015, from <http://www.coopercenter.org/demographics/national-population-projections>
- Vaughan, T. (1974). *Space, Style, and Structure: Building in Northwest America*. Portland: Oregon Historical Society.
- Vereecken, W., Van Heddeghem, W., Deruyck, M., Puype, B., Lannoo, B., & Joseph, W. (2011, July). Power Consumption in Telecommunications Networks: Overview and Reduction Strategies. *IEEE Communications Magazine*, pp. 62-69. Retrieved September 22, 2015, from <http://www.researchgate.net/publication/228774201>
- Water Resources Commission. (2015). *Oregon Water Resources Commission*. Retrieved November 2015, from <http://www.oregon.gov/owrd/pages/commis/index.aspx>
- Weber, W. A., & Wittmann, R. C. (2012). *Colorado Flora, Eastern Slope, A Guide to the Vascular Plants*. Tech. rep., University of Colorado Press, Boulder, CO. Retrieved from <https://www.jstor.org/stable/j.ctt46ntkd>
- Wilderness.net. (2015). *List Wilderness Areas by Location: Oregon*. Retrieved November 16, 2015, from <http://www.wilderness.net/NWPS/stateView?state=OR>
- WNHP. (2011). *Nelson's Checker-Mallow*. (P. Camp, & J. Gamon, Eds.) Retrieved from <http://www1.dnr.wa.gov/nhp/refdesk/fguide/pdf/sine2.pdf>
- World Wildlife Fund. (2015). *What is an ecoregion?* Retrieved from http://wwf.panda.org/about_our_earth/ecoregions/about/what_is_an_ecoregion/

GIS REFERENCES

- BIA. (2003, December). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2015, from <http://sagemap.wr.usgs.gov/ftp/regional/ind3.html> and <http://www.arcgis.com/home/item.html?id=2e915ef3df48422283e5b2c7d89dfcba>
- BLS. (2015). *Socioeconomics: Unemployment*. (GIS Metadata) Retrieved August 2015, from Local Area Unemployment Statistics, Employment status of the civilian noninstitutional population, 1976 to 2014 annual averages. State Data, Annual Average Series, Employment status of the civilian noninstitutional population, annual averages.: <http://www.bls.gov/lau/rdscnp16.htm>
- Digital Aeronautical Flight Information File. (2015, June). *Land Use, Recreation, and Airspace: MTR Airspace*. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: [https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services](https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products%20and%20Services)
- Digital Aeronautical Flight Information File. (2015, June). *Land Use, Recreation, and Airspace: SUA Airspace*. (GIS Metadata) Retrieved June 2015, from National Geospatial-Intelligence Agency: [https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products and Services](https://pki.geo.nga.mil/servlet/ShowHomepage?menu=Products%20and%20Services)
- Environmental Systems Research Institute (ESRI). (2016). *All Maps*. (GIS Metadata) Retrieved August 2015, from http://www.arcgis.com/home/group.html?owner=esri&title=ESRI%20Data%20%26%20Maps&content=all&_ga=1.174384612.712313298.1421186728&q=rivers&t=group&start=1

- FAA. (2015, June). *Infrastructure: Transportation*. (GIS Metadata) Retrieved June 2015, from Airport hubs data. Data is updated every 8 weeks. Data downloaded by state:
http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). *Land Use, Recreation, and Airspace: Composite Airspace*. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks:
http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). *Land Use, Recreation, and Airspace: Private Airspace*. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks. :
http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FAA. (2015, June). *Land Use, Recreation, and Airspace: Public Airspace*. (GIS Metadata) Retrieved June 2015, from Data is updated every 8 weeks.:
http://www.faa.gov/airports/airport_safety/airportdata_5010/
- FCC. (2014, June). *Infrastructure: FCC Towers*. (GIS Metadata) Retrieved August 2015, from Data was obtained through a more advanced search by BAH being in direct touch with Cavell, Mertz & Associates to obtain ALL the relevant data across the country.:
<http://wireless2.fcc.gov/UlsApp/AsrSearch/asrAdvancedSearch.jsp>
- FCC. (2014, June). *Infrastructure: FCC Wireless*. (GIS Metadata) Retrieved August 2015, from David F. LaBranche, P.E. Geospatial Information Officer (GIO) OASD (EI&E) 571-372-6768 at Defense Installations Spatial Data Infrastructure (DISDI).:
<http://www.broadbandmap.gov/data-download>
- FCC. (2015). *Infrastructure: FCC Fiber*. (GIS Metadata) Retrieved August 2015, from
<http://www.broadbandmap.gov/data-download>
- FHWA. (2015, September 14). *Infrastructure: Transportation*. (GIS Metadata) Retrieved September 14, 2015, from Byways and National Scenic Trails; Gary A. Jensen; Research Implementation Team Leader; FHWA; 1200 New Jersey Ave, SE Room E76-304:
<http://www.fhwa.dot.gov/byways/> https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- FHWA. (2015, August). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved August 2015, from National Scenic Byways Program. Data obtained by Gary A. Jensen, Research Implementation Team Leader, Office of Human Environment HEPH-30, Federal Highway Administration, 1200 New Jersey Avenue, SE Room E76-304, Washington, DC 20590, 202-366-2048, gary.je: <http://www.fhwa.dot.gov/byways/>
- Global Volcanism Program, Smithsonian Institute. (2010, November 2). *Geology: Volcanoes*. (GIS Metadata) Retrieved August 2015, from
<http://www.arcgis.com/home/item.html?id=429becc8c5a44feaa64f17578aff045e>
- National Atlas and Interagency Wild and Scenic Rivers Coordinating Council. (2009). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from NPS:
<https://www.rivers.gov/mapping-gis.php>
- National Audubon Society. (2015). *Biological Resources: Important Bird Areas*. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:
http://gis.audubon.org/arcgisweb/rest/services/NAS/ImportantBirdAreas_Poly/MapServer
- National Conference of State Legislatures. (2010). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2016, from
<http://www.ncsl.org/research/state-tribal-institute/list-of-federal-and-state-recognized-tribes.aspx#federal>

- National Heritage Areas Program Office. (2011). *Visual Resources: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive*. (GIS Metadata) Retrieved August 2015, from Department of Interior, National Parks Service, National Heritage Areas Program Office: <https://www.nps.gov/heritageareas/>
- Native Languages of the Americas. (2015). *Cultural Resources: Approximate Historic Boundaries of Tribes*. (GIS Metadata) Retrieved August 2015, from <http://www.native-languages.org/states.htm>
- NERR. (2012). *Water Resources: Surface Water / Watersheds*. (GIS Metadata) Retrieved August 2015, from NOAA, Office of Coastal Management, National Estuarine Research Reserve System (NERRS): <http://cdmo.baruch.sc.edu/get/gis.cfm>
- NPS. (2011). *Air Quality: Class 1 Areas*. (GIS Metadata) Retrieved August 2015, from <http://science.nature.nps.gov/im/gis/index.cfm>
- NPS. (2015). *Land Use, Recreation, and Airspace: Recreation*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior: <http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). *Visual Resources: Cultural Heritage*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]: <http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NPS. (2015, August). *Visual Resources: Cultural Heritage*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [National Monuments and Icons]: http://mapservices.nps.gov/arcgis/rest/services/cultural_resources/nhl_public/MapServer
- NPS. (2015, August). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from United States Park, National Parks Service, Department of Interior [National Scenic and Historic trails]: https://www.nps.gov/ncrc/programs/nts/nts_trails.html
- NPS. (2015, August). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from United States Park, NPS, Department of Interior [US Parks]: <http://www.arcgis.com/home/item.html?id=578968f975774d3fab79fe56c8c90941>
- NRCS. (2006). *Soils: Soil Suborders*. (GIS Metadata) Retrieved April 2015, from Downloaded by state-level: <https://gdg.sc.egov.usda.gov/>
- NRHP. (2015). *Cultural Resources: National Heritage*. (GIS Metadata) Retrieved August 2015, from Stutts M. 2014. NRHP. National Register properties are located throughout the U.S. and their associated territories around the globe.: <https://irma.nps.gov/DataStore/Reference/Profile/2210280>
- OWEB. (1999). *Water Resources: Surface Water / Watersheds*. (GIS Metadata) Retrieved March 2015, from Oregon Water Enhancement Board: <https://www.oregon.gov/OWEB/Pages/GIS.aspx>
- U.S. Census Bureau. (2015c). *Environmental Justice*. (GIS Metadata) Retrieved July 2015, from U.S. Environmental Protection Agency. "EJSCREEN Environmental Justice Mapping and Screening Tool: EJSCREEN Technical Documentation.": <http://www2.epa.gov/ejscreen/technical-documentation-ejscreen>
- U.S. Census Bureau. (2015f, April). *Socioeconomics: Population Distribution*. (GIS Metadata) Retrieved August 2015, from American Community Survey and Puerto Rico Community Survey 2013 Subject Definitions. 2013_ACSSubjectDefinitions: http://www2.census.gov/programs-surveys/acs/tech_docs/subject_definitions/2013_ACSSubjectDefinitions.pdf

- U.S. Census Bureau. (2015j). *Socioeconomics: Median Household Income*. (GIS Metadata) Retrieved August 2015, from American Community Survey, 2009-2013 5-Year Summary File, Table B02001, Race. Obtained via Census Bureau online DataFerrett tool.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). *Environmental Justice*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). *Socioeconomics: Median Household Income*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S., Puerto Rico, and Island Areas: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). *Socioeconomics: Population Distribution*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code, then USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. Census Bureau. (Undated(a)). *Socioeconomics: Unemployment*. (GIS Metadata) Retrieved August 2015, from "2010 Census Urban and Rural Classification and Urban Area Criteria." Lists of 2010 Census Urban Areas: A national, state-sorted list of all 2010 urbanized areas and urban clusters for the U.S. first sorted by state FIPS code then by USACE code.: <http://www.census.gov/geo/maps-data/data/tiger-data.html>
- U.S. DOT Bureau of Transportation Statistics National Transportation Atlas Database. (2015). *Infrastructure: Transportation*. (GIS Metadata) Retrieved August 2015, from Railroads, Major Highways data: http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_atlas_database/2015/polyline
- United States National Atlas. (2014). *Land Use, Recreation, and Airspace: Recreation*. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- United States National Atlas. (2014). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from http://nationalmap.gov/small_scale/
- USACE. (2015, March 17). *Infrastructure: Transportation*. (GIS Metadata) Retrieved August 2015, from Port Data. Has since been updated: <http://www.navigationdatacenter.us/gis/gis1.htm>
- USEPA. (2011). *Water Resources: Principal Aquifers*. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/dwssa/map-sole-source-aquifer-locations>
- USEPA. (2013). *Biological Resources: Ecoregions*. (GIS Metadata) Retrieved August 2015, from Level III and IV ecoregions of the continental United States. National Health and Environmental Effects Research Laboratory, Corvallis, Oregon, Map scale 1:3,000,000: http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm
- USEPA. (2014). *Water Resources: Impaired Water*. (GIS Metadata) Retrieved August 2015, from <https://www.epa.gov/waterdata/waters-geospatial-data-downloads>

- USEPA. (2015). *Human Health and Safety: TRI*. (GIS Metadata) Retrieved September 2015, from Web service, data is not saved locally:
<https://map11.epa.gov/arcgis/rest/services/NEPAssist/NEPAVELayersPublic>
- USEPA. (2015b, April 21). *Air Quality: Nonattainment Areas*. (GIS Metadata) Retrieved August 2015, from The Green Book Nonattainment Areas for Criteria Pollutants:
https://www3.epa.gov/airquality/greenbook/gis_download.html
- USFWS. (2014). *Wetlands*. (GIS Metadata) Retrieved August 2015, from State level data layer:
<https://www.fws.gov/wetlands/Data/Data-Download.html>
- USFWS. (2015). *Biological Resources: Critical Habitat*. (GIS Metadata) Retrieved September 2015, from <https://www.fws.gov/gis/data/national/>
- USFWS. (2015, December 4). *Land Use, Recreation, and Airspace: Recreation*. (GIS Metadata) Retrieved September 2015, from National Wildlife Refuge Boundaries:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USFWS. (2015, December 14). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from USFWS National Wildlife Refuge System, Realty Division:
<http://www.arcgis.com/home/item.html?id=7b90f9c5e8044d189a5764758ce3775e>
- USGS. (1999 to 2001). *Visual Resources: Land Cover*. (GIS Metadata) Retrieved August 2015, from USGS GAP Analysis Land Cover, National Land Cover Dataset; Landsat 7 ETM+; Imagery provided for Spring, Summer and Fall dates between 1999 and 2001:
<http://gapanalysis.usgs.gov/gaplandcover/data/download/>
- USGS. (2003, October). *Water Resources: Groundwater*. (GIS Metadata) Retrieved August 2015, from <http://water.usgs.gov/ogw/aquifer/map.html>
- USGS. (2010). *Geology: Surface Geology*. (GIS Metadata) Retrieved April 2015, from <http://www.arcgis.com/home/item.html?id=2967ae2d1be14a8fbf5888b4ac75a01f>
- USGS. (2012). *Cultural Resources: Physiographic Provinces*. (GIS Metadata) Retrieved April 2015, from Physiographic provinces and regions are made from the same dataset; downloaded by state-level:
http://services.arcgis.com/ZzrwjTRez6FJiOq4/arcgis/rest/services/US_PhysiographicProvinces/FeatureServer
- USGS. (2012). *Geology: Landslide Incidence*. (GIS Metadata) Retrieved May 2015, from Web service, data is not saved locally:
<https://www.arcgis.com/home/item.html?id=b3fa4e3c494040b491485dbb7d038c8a>
- USGS. (2013). *Geology: Karst Subsidence*. (GIS Metadata) Retrieved May 2015, from Two data layers within the same source show different varieties of Karst, and were published on different dates:
http://services.arcgis.com/hoKRg7d6zCP8hwp2/arcgis/rest/services/Appalachian_Karst_Features/FeatureServer
- USGS. (2014). *Geology: Seismic Hazard*. (GIS Metadata) Retrieved April 2015, from http://services.arcgis.com/VTyQ9soqVukalItT/arcgis/rest/services/USPGA_Seismic_Hazard/FeatureServer
- USGS, Protected Areas of the United States. (2012, 11 30). *Land Use, Recreation, and Airspace: Land Ownership*. (GIS Metadata) Retrieved August 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update:
<http://gapanalysis.usgs.gov/padus/data/download/>
- USGS, Protected Areas of the United States. (2012, November 30). *Land Use, Recreation, and Airspace: Recreation*. (GIS Metadata) Retrieved September 2015, from Data was updated

in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
USGS, Protected Areas of the United States. (2012, November 30). *Visual Resources: Cultural Heritage*. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update.:
<http://gapanalysis.usgs.gov/padus/data/download/>
USGS, Protected Areas of the United States. (2012, November 30). *Visual Resources: Natural Areas*. (GIS Metadata) Retrieved September 2015, from Data was updated in 5/5/2016. Maps were completed in December 2015 prior to this update. :
<http://gapanalysis.usgs.gov/padus/data/download/>

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