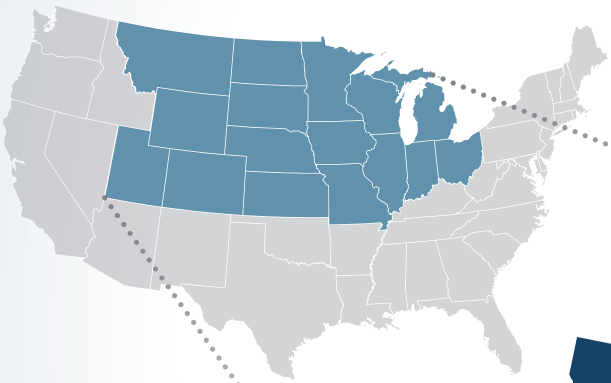
FirstNet®

Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 1 - CHAPTERS 1-3



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First Responder Network Authority

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Nationwide Public Safety Broadband Network

Draft Programmatic Environmental Impact Statement for the Central United States

VOLUME 1 - CHAPTERS 1-3

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

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1.0 INTRODUCTION

1.1. OVERVIEW AND BACKGROUND

Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, 126 Statute [Stat. 156 (2012)) (codified at 47 United States Code [U.S.C.] § 1401 et. seq.) (the Act) created and authorized the First Responder Network Authority (FirstNet) to ensure the establishment of a nationwide public safety broadband network (NPSBN) based on a single, national network architecture (47 U.S.C. § 1422(b)). FirstNet was created as an independent authority within the Department of Commerce's National Telecommunications and Information Administration (NTIA), the Executive Branch agency that is principally responsible for advising the president on telecommunications and information policy issues.

The Act meets a long-standing and critical national infrastructure need to create a nationwide broadband network that would, for the first time, allow police officers, fire fighters, emergency medical service professionals, and other public safety officials to effectively communicate with each other across agencies and jurisdictions. The NPSBN (i.e., the Proposed Action) is intended to cover all 50 states, 5 territories, and the District of Columbia.

The Act charges FirstNet with taking all actions necessary to ensure the building, deployment, and operation of NPSBN by (at a minimum):

- Ensuring nationwide standards for use and access to the network (47 U.S.C. § 1426(b)(1)(A));
- Issuing open, transparent, and competitive requests for proposals to the private sector (47 U.S.C. § 1426(b)(1)(B));
- Encouraging use of existing commercial wireless infrastructure to speed deployment (47 U.S.C. § 1426(b)(1)(C)); and
- Managing and overseeing private sector entities that build, operate, and maintain the network (47 U.S.C. § 1426(b)(1)(D)).

In addition to these requirements, the Act mandates careful consideration of rural areas. This includes requiring FirstNet, to the maximum extent economically desirable, to include deployment phases with substantial rural coverage milestones as part of each construction and deployment phase of the network (47 U.S.C. § 1426(b)(3)).

The lack of interoperability in public safety communications, and the hazards associated with it, have been known within the public safety community and the telecommunications industry for quite some time. In 1996, the Public Safety Wireless Advisory Committee (PSWAC), which was established by the Federal Communications Commission (FCC) and NTIA in 1995, published a report on the current state of public safety wireless communications (Public Safety Wireless Advisory Committee, 1996).

The report identified three major problems:

1. The radio frequencies allocated to public safety were congested and growing more so.
2. The ability of officials from different public safety agencies to communicate with each other was limited due to multiple frequency bands, incompatible equipment, and a lack of standardization in repeater spacing and transmission formats.
3. Public safety officials were unable to effectively pursue their missions because they were not able to take advantage of cutting-edge communications technologies that would make their job performance safer and more efficient.

The report concluded that "unless immediate measures are taken to alleviate spectrum shortfalls and promote interoperability, public safety agencies will not be able to adequately discharge their obligation to protect life and property in a safe, efficient, and cost effective manner" (Public Safety Wireless Advisory Committee, 1996). The report went on to describe interoperability issues that hampered emergency response activities in the 1993 World Trade Center bombing in New York City and the 1995 Oklahoma City bombing of the Alfred P. Murrah Federal Building. It further emphasized that these concerns also applied to more routine, day-to-day emergency response activities, and that the needs of the public safety community—with regard to security, resilience, redundancy, and coverage—were unique and mission-critical.

Although the communications challenges facing the public safety community were known, the true genesis of the NPSBN lies with the 9/11 Commission Report (the Report), published on July 22, 2004 (National Commission on Terrorist Attacks upon the United States, 2004). This report analyzed the terrorist attacks of September 11, 2001, and sought to provide recommendations and new paths forward to ensure greater public safety based on the events that transpired on that day. The Commission interviewed more than 1,200 individuals and reviewed millions of pages of documents in an effort to understand how the attacks were possible and how to best attempt to prevent such a tragedy from ever recurring.

The Report identified a critical need for improved communications capabilities for the public safety community through the "expedited and increased assignment of radio spectrum for public safety purposes" (National Commission on Terrorist Attacks upon the United States, 2004). As numerous on-site reports from public safety personnel at the World Trade Center (NY), the Pentagon (DC), and Somerset County (PA) indicated, the lack of interoperable communications capability among the multiple police, fire, and emergency medical services personnel hampered rescue efforts and in many cases likely led to an increased loss of life. Hundreds of police officers and fire fighters, including off-duty personnel who reported to the scene to engage in rescue efforts upon learning of the events that were unfolding, were killed in the line of duty; this amounted to the largest loss of first responders in a single event anywhere in history (National Commission on Terrorist Attacks upon the United States, 2004). In 2012, the Act created FirstNet with the primary purpose of designing, building, and operating a dedicated public safety communications network to provide first responders with the tools they need to do their jobs more effectively, and to minimize the loss of life in the event of any future natural or manmade emergencies or disasters.

The Act also establishes a process allowing states and territories to determine whether to participate in the FirstNet proposed network for that state or conduct their own deployment of a radio access network (RAN) in their respective states (47 U.S.C. § 1442(e)). A state that chooses to deploy its own RAN is required by the Act to follow certain procedural requirements, including submitting an alternative plan to the FCC for deployment/construction, maintenance, and operation of the RAN within that state. If the FCC approves the alternative plan, the state could apply to NTIA for a grant to construct the RAN within the state and must apply to NTIA to lease spectrum capacity from FirstNet (47 U.S.C. § 1442(e)(3)(C)).

The Act establishes in the U.S. Department of the Treasury a fund known as a "Network Construction Fund." This fund must be used by FirstNet to carry out its statutory mission. The source of the funds to be deposited came from the proceeds of incentive auctions that are authorized under the Act. Prior to the deposit of proceeds from the incentive auctions, Congress authorized NTIA to borrow up to $2 billion from the Treasury in order for FirstNet to carry out its responsibilities under the Act (47 U.S.C. § 1427(a)). However, NTIA is required to reimburse the Treasury (without interest) for any of the funds borrowed with the proceeds it receives from incentive auctions.

As a federal entity, FirstNet is required to comply with the National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. . § 4321 et seq.), which requires that the government examine the environmental, social, historic, and cultural impacts of its Proposed Actions before it irretrievably commits resources to undertake them. Furthermore, FirstNet must comply with its own NEPA implementing instructions, which were finalized and published in the Federal Register (79 FR 23945 April 29, 2014). FirstNet published a Notice of Intent (NOI) in the Federal Register to prepare five coordinated Programmatic Environmental Impact Statements (PEISs) (79 FR 67156 November 12, 2014). The PEISs analyze the potential direct, indirect, and cumulative impacts of the proposed action as well as alternative approaches to the construction, operation, and maintenance of the NPSBN on natural, cultural, and social resources. Each of the five PEISs analyzes potential impacts in a particular region of the country.

1.2. PROGRAMMATIC APPROACH AND TIERING

A programmatic environmental document, such as the five coordinated PEISs being developed for the Proposed Action, is prepared when an agency is proposing to carry out a broad action, program, or policy. FirstNet has determined that the design, deployment/construction, and operation of the NPSBN is a broad action with nationwide implications. This approach, which considers the full planning area, provides for the broadest and most extensive NEPA analysis in order to support the balancing of different considerations, including social, economic, historic, and environmental issues. Furthermore, the programmatic approach creates a comprehensive analytical framework that assesses potential impacts expected from the program as a whole. It also supports any subsequent site-specific environmental analyses that may be required for individual actions at specific locations, once they are identified. Finally, and as discussed in the introduction to each of the Environmental Consequences sections, the programmatic approach allows FirstNet to identify and define four categories of actions and associated levels of potential impact as described below:

- *Potentially significant,* where there is substantial evidence that an effect may be significant;
- *Less than significant with best management practices (BMPs) and mitigation measures incorporated*, where the use of mitigation measures reduce an effect from a *potentially significant* impact to a *less than significant* impact;
- *Less than significant*, where the action creates impacts but no significant impacts; or
- *No impact,* which applies where an action does not create an impact.

To streamline the NEPA process and avoid repetition, the White House Council on Environmental Quality (CEQ) regulations encourage federal agencies to develop a tiered approach to their analyses (40 Code of Federal Regulations [CFR] 1502.20), by working from broad, general NEPA documents addressing large-scale program-level impacts and decisions down to site-specific documents. The PEISs are intended to provide broad analysis and direction regarding the overall potential impacts of the NPSBN. When a proposed network design is ready, and specific sites are proposed for deployment, the decision to deploy the NPSBN would not be revisited; instead subsequent memoranda, Categorical Exclusions (CEs), Environmental Assessments (EAs), or EISs would be "tiered" off of the PEISs, and would summarize, or incorporate by reference, much of the detailed analyses presented in the PEISs as a means of streamlining the NEPA process (40 CFR Part 1500.4[I]). To satisfy NEPA, a Record of Environmental Consideration (REC) would be prepared for activities associated with the design, deployment/construction, and operation of the NPSBN that fall within the range of activities analyzed in the PEISs and do not have any extraordinary circumstances that would require further study. Site-specific actions, once defined, would be evaluated against the analyses presented in the programmatic review for future NEPA compliance, and the appropriate level of NEPA review would be determined by FirstNet and developed accordingly.

1.3. Project Regions and Description of the Proposed Action Area

FirstNet, in consultation with CEQ, decided to analyze the potential impacts of the NPSBN in five regions, as shown in Figure 1.3-1.

The single, unified analysis for the entire NPSBN has been divided into the five regions as described above to provide a greater depth of information and to more efficiently support FirstNet's mission objectives. The FirstNet PEIS Proposed Action area would cover the geography of the 50 states, the 5 territories, the District of Columbia, and 567 tribal nations.

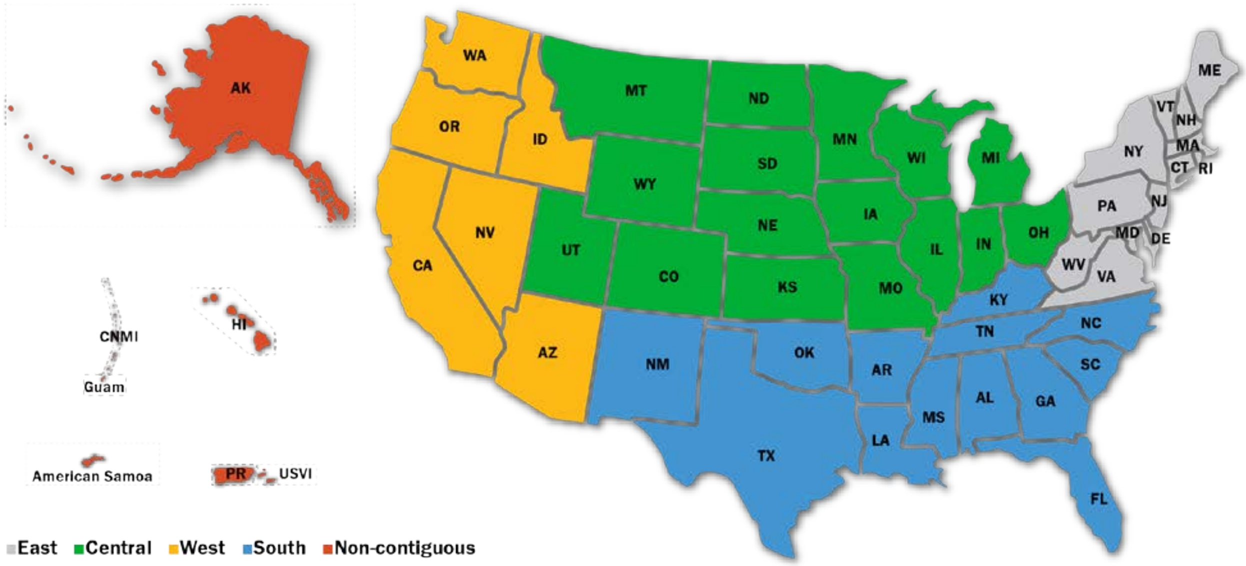

Figure 1.3-1: FirstNet PEIS Regions of Analysis

This PEIS focuses on the Central region encompassing 16 states: Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. To aid the reader, the existing environment and environmental consequences are compiled into state-specific chapters.

1.4. Purpose and Need for the Proposed Action

The purpose of the Proposed Action is to develop the NPSBN. The NPSBN is intended to facilitate the use of rugged, easy-to-use devices and provide a set of applications and services on a single, interoperable platform built to open, non-proprietary commercially available standards for emergency and daily public safety communications. These applications and services would enhance the ability of the public safety community to perform more reliably, effectively, and safely. The NPSBN would also provide a backbone to allow for improved communications by carrying high-speed data, location information, images, and eventually, streaming video. This capability would increase situational awareness during an emergency, thereby improving the ability of the public safety community to effectively engage and respond.

The FirstNet network would be "hardened" from the physical layer, user access, and cyber security perspectives to be more resilient to impacts from natural and man-made disasters. Hardening refers to a variety of methods that may be used to make a structure more resistant to failure, whether through physical reinforcement of a structure, redundant sources of emergency power, or additional firewalls and cybersecurity measures. These efforts would be designed not only to ensure that the network has greater resistance to system failure than what is currently available, but also that it can recover more rapidly should failure occur at any point in the system. The goal would be to provide not only interoperability, but also improved operability in the event of a natural or manmade disaster. The network operating standards would also provide local control to public safety agencies, allowing for more control over the configuration, deployment, and management of multiple types of information technology resources, referred to as provisioning, as well as device features, and reporting.

The Proposed Action is needed to address existing deficiencies in public safety communications interoperability, durability, and resiliency that have been highlighted in recent years for the ways in which they have hindered response activities in high profile natural and manmade disasters. Today, first responders rely on numerous separate, incompatible, and often proprietary land mobile radio networks. This makes it difficult, and at times impossible, for emergency responders from different jurisdictions to communicate, especially during major emergencies that require a multi-jurisdictional response (National Task Force on Interoperability, 2005).

During the September 11 attacks, members of the public safety community, who risked their own safety on behalf of others, were unable to communicate with each other on radio systems operating on different, incompatible frequencies. Additionally, emergency messages could not reach first responders as wireless and wire-line networks were overwhelmed with traffic. At the Pentagon, commanders had to resort to sending runners with paper messages to forward instructions to those trying to save as many lives as possible.

In the years that followed these events, the federal government provided billions of dollars and valuable radio spectrum to promote interoperability and improve operations (Congressional Research Service, 2011). Subsequent disasters, however, have shown that public safety response is still often compromised by an inability to communicate due to radio systems operating on different, incompatible frequencies. This is largely the result of the fragmented initial design and uncoordinated upgrades of public safety communications. Most upgrades were planned and executed at the local level; what was lacking was an overarching plan to connect all first responders under one dedicated interoperable system.

Four years after September 11, the Hurricane Katrina disaster response in August 2005 highlighted the equally fundamental challenge of operability. The collapse of critical infrastructure proved challenging throughout most of the region affected, as failures in one sector led to failures in others. The physical communications infrastructure in Louisiana, Mississippi, and Alabama was devastated, with more than 3 million customer telephone lines destroyed; in New Orleans, only two FM and two AM radio stations out of 41 survived the storm and subsequent flooding. Almost 2,000 cell towers were knocked out, which severely degraded LMR communications. At one time, more than 35 Public Safety Answering Points (PSAPs) were out of service, which resulted in a weeks-long, sustained loss of 911 services in some parts of the region (Miller, 2006). This rendered the issue of interoperability moot, since the equipment and infrastructure on which the system relied were not operable to begin with (United States House of Representatives, 2005).

Many of these same challenges presented themselves again in October 2013 when Hurricane Sandy battered the northeast United States. At the peak of the storm, approximately 25 percent of all cell sites across 10 states and the District of Columbia were out of service, resulting in the same loss of basic operability seen in previous events (Hurricane Sandy Rebuilding Task Force, 2013). The loss of power and loss of backhaul capacity[1] significantly impacted the functionality of the telecommunications infrastructure in the affected regions; one of the recommendations of the Hurricane Sandy Recovery Task Force was to "develop a resilient power strategy for wireless and data communications infrastructure and consumer equipment." (Hurricane Sandy Rebuilding Task Force, 2013) This underscored the need for a disaster-resistant network that could continue to function in an emergency, and that could recover quickly from a failure at a single point somewhere in the system without that point failure causing a ripple effect of failures throughout the system.

In May 2014, the National Public Safety Telecommunications Council (NPSTC) published its final report, Defining Public Safety Grade Systems and Facilities, which provides information and recommendations for resiliency and durability in a communications system designed to resist failures due to manmade or natural disasters (National Public Safety Telecommunications Council, 2014). The NPSBN is intended to have a higher level of redundancy and resiliency than current commercial networks in order to support the public safety community effectively.

1.5. Federal Agency Participation

1.5.1. Lead Agency

As noted in Section 1.1, Overview and Background, FirstNet is the lead agency for the environmental review consistent with NEPA, the National Historic Preservation Act of 1966 (NHPA) Section 106 consultation process, and the Endangered Species Act (ESA) Section 7 consultation process for the Proposed Action. As the lead agency, FirstNet is directing the development of the five PEISs, the tribal consultation process, and has initiated consultation with the U.S. Fish and Wildlife Service (USFWS) to determine the likelihood of potential effects on listed species and migratory birds. FirstNet is also coordinating with cooperating agencies to ensure compliance with the laws, regulations, and executive orders (EOs) discussed in Section 1.8, Overview of Relevant Laws and Executive Orders and Appendix C, Environmental Consequences and Regulations.

1.5.2. Cooperating Agencies

Lead agencies, such as FirstNet, that are preparing a NEPA document are required to do so in cooperation with other federal, state, and/or local agencies with jurisdiction by law or with special expertise with respect to an environmental impact involved in the proposal (40 CFR 1508.5). Outside of the scoping process, this cooperation can be formalized between the lead agency and another agency with a Memorandum of Understanding that formalizes the cooperating agency status and responsibilities.

In letters dated January 16, 2015, FirstNet invited 37 federal agencies to participate in the development of the PEISs as cooperating agencies. Eight agencies accepted the invitation: the FCC, the General Services Administration (GSA), the U.S. Department of Agriculture's (USDA)

[1] Backhaul capacity refers to the ability of a network to transfer data from a radio base station or cell site to a larger core network. These connections are typically made via fiber optic cable and microwave technology.

Rural Utilities Service (RUS), the USDA's U.S. Forest Service (USFS), the USDA's Natural Resources Conservation Service (NRCS), the U.S. Air Force (USAF), the U.S. Department of Energy (DOE), and the U.S. Department of Homeland Security (DHS), including the Federal Emergency Management Agency (FEMA), the U.S. Coast Guard (USCG), and the U.S. Customs and Border Protection (CBP). Appendix A contains a complete list of those agencies invited to become cooperating agencies.

1.5.3. Consulting Parties

Under the Act, FirstNet is required to conduct all consultation and network planning activities in a given state or territory through a governor-appointed State Single Point of Contact (SPOC) (47 U.S.C. § 1442(d)). In a letter dated April 29, 2015, FirstNet invited all 56 SPOCs to be consulting parties on the development of the PEISs, to promote transparency and partnership with the SPOCs. As of the date of publication, 13 SPOCs accepted the invitation, which afforded them the opportunity to review and comment on draft documents prior to public release.

1.6. CULTURAL RESOURCES CONSULTATION

As a federal entity, FirstNet has obligations under the NHPA to understand and address the potential impacts of its proposed undertakings on historic properties; one of the ways in which this is accomplished is through consultation with State Historic Preservation Offices (SHPOs) and government-to-government consultation with federally recognized American Indian tribes. As the lead agency for compliance with Section 106 of the NHPA, FirstNet is committed to meaningful engagement with Tribal Nations. In a letter dated January 30, 2015, FirstNet contacted tribal leaders and Tribal Historic Preservation Officers (THPOs), where applicable, to initiate formal, government-to-government consultation with all 567 federally recognized American Indian tribes. As of the date of publication, FirstNet received responses from 38 tribes with requests to consult on the Proposed Action.

1.7. THE NEPA PROCESS AND PUBLIC INVOLVEMENT

Under NEPA, the primary objectives of each PEIS are to:

- Identify and assess potential impacts on the natural and human environment that would result from implementation of the Proposed Action;
- Describe and evaluate reasonable alternatives, including the Preferred Alternative, a No Action Alternative, and other alternatives that would avoid or minimize adverse effects to the environment;
- Identify and recommend specific BMPs and mitigation measures, as necessary, to avoid or minimize potential environmental, social, historic, and cultural impacts; and
- Facilitate public, tribal, and agency involvement in identifying significant environmental impacts.

This section provides an overview of the overall PEIS public involvement process (see Section 1.7.1), and more specifically, the scoping process for the Draft PEISs (see Section 1.7.2).

1.7.1. Public Involvement

NEPA requires draft and final versions of a PEIS to be published, fostering public involvement through two public opportunities: 1) the scoping public comment period prior to the preparation and publication of the Draft PEIS, and 2) the Draft PEIS public comment period prior to the preparation and publication of the Final PEIS. FirstNet has engaged with the public to provide opportunities for comment in full compliance with the letter and spirit of the law.

The content of a Draft PEIS is based on a process called "scoping." The regulations implementing NEPA require that scoping be included in the environmental analysis process (40 CFR Part 1501.7). Scoping for the Draft PEIS included several key elements: 1) gathering information and ideas from the public and key stakeholder groups, such as the public safety community, about the analytical issues related to the NPSBN; 2) making determinations about which issues should be analyzed; and 3) identifying alternatives to the proposal that warranted analysis. The scoping process is ongoing and critical to informing agency actions, in that it begins before the PEIS analyses are initiated and continues throughout document development.

1.7.2. Scoping

On November 12, 2014, FirstNet published a NOI in the *Federal Register* to prepare five coordinated PEISs (79 FR 67156 [November 12, 2014]). This publication kicked off a 45-day public scoping comment period wherein members of the public were able to submit comments to FirstNet via traditional mail or via e-mail. A series of public scoping meetings were also held where participants had the opportunity to learn about the Proposed Action, talk directly with FirstNet environmental staff, and provide input regarding the scope and analysis of the Proposed Action. The public meetings were held in the following locations:

- Washington, D.C.: Tuesday, November 25, 2014; 4:00 – 8:00 p.m.
- Honolulu, HI: Tuesday, December 2, 2014; 4:00 – 8:00 p.m.
- San Francisco, CA: Thursday, December 4, 2014; 4:00 – 8:00 p.m.
- Tucson, AZ: Thursday, December 4, 2014; 4:00 – 8:00 p.m.
- Kansas City, MO: Tuesday, December 9, 2014; 4:00 – 8:00 p.m.
- New Orleans, LA: Thursday, December 11, 2014; 5:00 – 9:00 p.m.
- New York, NY: Monday, December 15, 2014; 4:00 – 8:00 p.m.

The Scoping Summary Report may be found in Appendix B. The following major items were identified during the scoping comment period and in public meetings:

- Potential impacts of the NPSBN on sensitive natural resources;
- Concerns regarding the impacts of tower placement on culturally and ecologically sensitive areas, such as Tumamoc Hill in Tucson, AZ; and
- The impact of the NPSBN on existing public safety communications infrastructure and operations.

FirstNet continued to accept comments after the close of the formal scoping period to allow the public as many opportunities as possible to provide input. Additional comments were received on the topics mentioned above, as well as on the topic of potential impacts of radio frequency (RF) radiation.

1.8. Overview of Relevant Federal Laws and Executive Orders

This section will provide a brief explanation of major federal laws and executive orders (EOs) that are relevant to this Proposed Action. Given the expected nature and extent of the proposed NPSBN, it is likely that a wide range of diverse resources could be potentially impacted to varying degrees, including wetlands, coastal areas, farmland, wildlife, marine areas, migratory birds, and social or cultural resources, among others. Therefore, there are multiple laws and EOs that FirstNet is obliged to consider as part of this analysis. This is not intended to be a comprehensive list of all applicable laws and EOs; instead it provides context with regard to those laws and EOs that are most likely to be directly triggered by the Proposed Action. Appendix C provides a comprehensive list of applicable laws and regulations that were considered as part of the Proposed Action.

1.8.1. National Environmental Policy Act

NEPA (42 U.S.C. 4321 et seq.) requires federal agencies to integrate environmental values into their decision-making processes by considering the environmental impacts of their Proposed Actions and reasonable alternatives to those actions. NEPA also established CEQ. As part of the Executive Office of the President, CEQ coordinates federal environmental efforts and is responsible for advising the president on environmental policy matters. CEQ has also promulgated regulations implementing NEPA, which are binding on all federal agencies. These regulations address the procedural provisions of NEPA and the administration of the NEPA process, including preparation of EISs.

NEPA is applicable to all “major” federal actions affecting the quality of the human environment. A major federal action is an action with effects that may be major and which are potentially subject to federal control and responsibility. These actions may include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised agency rules, regulations, plans, policies, or procedures; and legislative proposals. FirstNet has determined the deployment/construction, operation, and maintenance of the NPSBN qualifies as a major federal action under these criteria and therefore requires a review under NEPA.

1.8.2. National Historic Preservation Act

The goal of the NHPA (formerly 16 U.S.C. § 470 et seq., now 54 U.S.C. § 100101 et seq.) is to empower federal agencies to act as responsible stewards of cultural resources when agency actions affect historic properties. The NHPA established the Advisory Council on Historic Preservation (ACHP), an independent federal agency that promotes the preservation, enhancement, and productive use of our nation’s historic resources, and advises the President and Congress on national historic preservation policy. The NHPA also authorizes the Secretary of the Interior to expand and maintain a National Register of Historic Places composed of districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering, and culture.

Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register. In carrying out their NHPA responsibilities under Section 106, federal agencies are required to consult with federally recognized American Indian tribes and Native Hawaiian Organizations that attach traditional religious and cultural significance to eligible or listed historic properties that could potentially be affected by the agency's actions. The intent of the consultation is to identify historic properties potentially affected by the undertaking and to seek ways to avoid, minimize, or mitigate any adverse effects on those properties.

The NHPA details a four-step process for Section 106 consultation that requires each federal agency to: 1) initiate a review process to evaluate any proposed action; 2) identify historic properties that could be affected by the proposed federal, or federally licensed, permitted, or funded, action; 3) assess whether the action has the potential to affect properties that are listed in or are eligible for listing in the National Register of Historic Places; and 4) resolve the adverse effects. FirstNet has determined that the deployment/construction, operation, and maintenance of the NPSBN qualifies as an undertaking under Section 106, and will, therefore, require analysis under NHPA.

1.8.3. Endangered Species Act

The ESA (16 U.S.C. § l53l et seq.) was established to conserve and protect threatened and endangered species. Under most circumstances, the ESA prohibits take, which is defined as harming, up to and including loss of life, or harassing a listed species. Section 2 of the ESA sets forth the purposes and policy, which include providing a means to conserve endangered and threatened species' ecosystems and providing programs for the conservation of such species. The ESA requires federal agencies to conserve threatened and endangered species, and use their authorities to further the purposes of the ESA.

Accordingly, Section 7 of the ESA requires each federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any threatened or endangered species or result in destruction or adverse modification of critical habitat for such species. Federal agencies are further required to consult with the appropriate federal agency, either the USFWS or the National Marine Fisheries Service (NMFS), for federal actions that "may affect" a listed species or adversely modify critical habitat. Federal agencies must use the best scientific and commercial data available when making an effect determination relating to the impact of their actions. Given the likely extent of the NPSBN, FirstNet has determined consultation under the ESA is required to determine whether there are any expected impacts to threatened and endangered species or their critical habitat.

1.8.4. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. § 1801 et seq.) is the primary law governing fisheries management in U.S. federal waters. The MSA is intended to foster long-term biological and economic sustainability of U.S. marine fisheries through the prevention of overfishing, the rebuilding of overfished stocks, and increasing long-term economic and social benefits to ensure a safe and sustainable supply of seafood. The MSA extended U.S. jurisdiction from 12 nautical miles to 200 nautical miles and established eight regional fisheries management councils to develop Fishery Management Plans (FMPs), which must comply with conservation and management standards to promote sustainable fisheries management. The FMPs also define essential fish habitat (EFH), which is the aquatic habitat where fish spawn, breed, feed, and grow through various life stages; this habitat includes marine waters, wetlands, coral reefs, seagrasses, and rivers. The FMPs further define habitat areas of particular concern (HAPCs), which are high priority areas that are rare, particularly sensitive, or critical to overall ecosystem functions. FirstNet may encounter marine resources in the deployment/construction and operation of the NPSBN, particularly for those parts of the network intended to provide coverage and service to coastal areas.

1.8.5. Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) (16 U.S.C. § 1361 et seq.) prohibits takes of all marine mammals in the U.S. (including territorial seas) with few exceptions. Permits for scientific research on marine mammals and permits to enhance the survival or recovery of a species, issued under Section 104 of the MMPA, are two such exceptions, neither of which would likely be pursued by FirstNet as part of the Proposed Action. For threatened and endangered marine mammals, any activities that may affect ESA-listed species must be consistent with the ESA as well. Deployment/construction, operation, and maintenance of the NPSBN may include activities that occur in or adjacent to marine areas for those parts of the network intended to provide coverage to coastal areas, including mainland and island coastlines.

1.8.6. Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. § 703-712) was enacted to ensure protection of migratory bird resources that are shared among the U.S., Canada, Mexico, Japan, and Russia. The MBTA prohibits the take, possession, import, export, transport, selling, purchase, barter, or offering for sale, purchase, or barter, of any migratory bird, their eggs, parts, and nests, except as authorized under a valid permit. The responsibilities of federal agencies to protect migratory birds are set forth in EO 13186 (see below). USFWS is the lead agency for migratory birds. The USFWS issues permits for takes of migratory birds for activities such as scientific research, education, and depredation control, but does not issue permits for incidental take[2] of migratory birds. FirstNet activities, such as tower construction, would have the potential to impact

[2] Section 704 of the Migratory Bird Treaty Act describes a take as "hunting, taking, capture, killing, possession, sale, purchase, shipment, transportation, carriage, or export of any such bird, or any part, nest, or egg thereof."

migratory bird species; therefore, FirstNet is obliged under the MBTA and EO 13186 to analyze the potential impacts of such actions.

1.8.7. Clean Water Act

The Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA) (33 U.S.C. § 1251 et seq.), establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters. The CWA defines waters of the U.S. to include all interstate waters, lakes, rivers, streams, territorial seas, tributaries to navigable waters, interstate wetlands, wetlands that could affect interstate or foreign commerce, and wetlands adjacent to other waters of the U.S. The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, without a permit. Under Sections 303 and 305 of the CWA, states must review all "existing and readily available" state surface water quality data to compare against their water quality standards and determine whether water bodies will be classified as higher quality (Category 1 or 2) or lower quality (Categories 3, 4, or 5). A water pollution reduction plan, or total maximum daily load (TMDL), may be required for water bodies that are classified as lower quality. The TMDL defines the upper threshold of a given pollutant that a waterbody can contain and still meet water quality standards.

Under Section 401 of the CWA, discharges of pollutants, such as stormwater from point or nonpoint sources[3] into waters of the U.S. are authorized through the National Pollutant Discharge Elimination System (NPDES) permitting program. The U.S. Environmental Protection Agency (USEPA) and delegated states and territories administer the NPDES permitting program. As part of this program, general NPDES permits are required to regulate stormwater discharges associated with construction activities that disturb one or more acres of land. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material into waters of the United States. Under the CWA, if FirstNet intends to carry out ground disturbing activity in or adjacent to waters of the United States, then permits and analyses may be required.

1.8.8. Coastal Zone Management Act

Congress enacted the Coastal Zone Management Act (CZMA) (16 U.S.C. § 1451 et seq.) to protect the coastal environment from growing demands associated with residential, recreational, commercial, and industrial uses (such as state and federal offshore oil and gas development). Coastal states with an approved Coastal Zone Management Plan, which defines permissible land and water use within the state's coastal zone, can review federal actions (such as deployment/ construction, operation, and maintenance of the Proposed Action), licenses, or permits for federal

[3] Section 502 (14) of the CWA defines point source pollution as pollution that comes from "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged." Nonpoint source pollution is defined as any source of water pollution that does not meet the legal definition of "point source," and includes runoff from rain or snowmelt that picks up natural and manmade pollutants, such as fertilizers, oils, salt, bacteria, and others that are eventually deposited into lakes, rivers, streams, wetlands, coastal water, and groundwater.

consistency. Federal consistency is the requirement that those federal permits and licenses likely to affect any land/water use or natural resources of the coastal zone be consistent with the state program's enforceable policies. Deployment/construction of the NPSBN is likely to occur in coastal areas; therefore, consistency determinations under CZMA may be required.

1.8.9. Occupational Safety and Health Act

The Occupational Safety and Health Act of 1970 (OSH Act (29 U.S.C. § 658)) created the Occupational Safety and Health Administration (OSHA) for the purpose of ensuring safe and healthful working conditions. OSHA pursues this mission by setting and enforcing standards in the workplace to create an environment free from hazards that include exposure to toxic substances, excessive noise, unsanitary conditions, and other physical hazards such as mechanical dangers and heat or cold stress. The OSH Act covers most private sector (and some public sector) employers and their workers either directly at the federal level, through OSHA, or through an OSHA-approved state plan, which defines and implements state-level worker health and safety programs and enforcement standards. Currently, 22 states and territories have OSHA-approved state plans. Deployment/construction, operation, and maintenance activities required for the deployment of the NPSBN would be required to comply with OSHA standards or OSHA-approved state plans.

1.8.10. Executive Order 11988 – Floodplain Management

EO 11988 requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities" for the following actions:

- Acquiring, managing, and disposing of federal lands and facilities;
- Providing federally undertaken, financed, or assisted construction and improvements; and
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

The guidelines address an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. This eight-step process can be addressed as part of the NEPA compliance process if an EA or EIS, such as this PEIS, is developed. Aspects of EO 11988 have been updated in EO 13690 (see Section 1.8.14).

1.8.11. Executive Order 11990 – Protection of Wetlands

The purpose of EO 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." To meet these objectives, federal agencies are required, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The EO applies to the following:

- Acquisition, management, and disposition of federal lands and facilities construction and improvement projects that are undertaken, financed, or assisted by federal agencies; and
- Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

The procedures require the determination of whether or not the proposed project would be in wetlands or would affect them. If so, a wetlands assessment must be prepared that describes the alternatives considered. The procedures include a requirement for public review of assessments. The evaluation process follows the same eight steps as for EO 11988, Floodplain Management. As with EO 11988, this eight-step process can be addressed as part of the NEPA compliance process if an EA or EIS, such as this PEIS, is developed.

1.8.12. Executive Order 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

The purpose of EO 12898 is to ensure that federal agencies avoid taking actions that have a disproportionately high and adverse impact on low-income populations or minority populations. Each federal agency must make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health, environmental, economic, and social effects of its programs, policies, and activities on minority and low-income populations, particularly when such analysis is required by NEPA. The EO emphasizes the importance of NEPA's public participation process, directing that each federal agency shall provide opportunities for community input in the NEPA process. Agencies are further directed to identify potential effects, BMPs, and mitigation measures in consultation with affected communities.

1.8.13. Executive Order 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds

The purpose of EO 13186 is to direct federal agencies to take certain actions to further implement the MBTA. Several international, bilateral conventions on migratory birds, of which the United States is a co-signatory, impose substantive obligations on the United States for the conservation of migratory birds and their habitats. Through the MBTA, the United States has implemented these migratory bird conventions with respect to this country. The EO directs each federal agency whose actions are likely to create a measurable, negative effect on migratory bird populations to enter into a Memorandum of Understanding (MOU) with the USFWS to promote the conservation and mitigation of impacts to migratory birds. Furthermore, the EO established the interagency Council for the Conservation of Migratory Birds to enhance coordination and communication among federal agencies regarding their responsibilities under the four bilateral treaties on the conservation of migratory birds.

1.8.14. Executive Order 13690 – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input

The purpose of EO 13690 is to implement the Federal Flood Risk Management Standard as part of a national policy on resilience and risk reduction, consistent with the President's Climate Action Plan. The EO amends EO 11988, and emphasizes consideration by agencies of ecosystem-based alternatives and long-term resilience and risk reduction when managing flood risks. The order establishes a process for further solicitation and consideration of public input and a science-based approach to defining floodplains and flood hazard areas.

1.9. PEIS Organization

This Draft PEIS includes descriptions of the affected environment, potential impacts, and alternatives of the Proposed Action, including cumulative impacts, in each of the 16 states and territories that make up the Central region. The structure and contents of this document have been developed consistent with NEPA requirements. The main organization of this document is as follows:

- Chapter 1: Introduction;
- Chapter 2: Description of the Proposed Action and Alternatives;
- Chapters 3 through 18: Each chapter contains a state-by-state analysis of the affected environment (including descriptions of the portions of the environment that could be affected by the Proposed Action), environmental consequences (including descriptions of the potential environmental, social, historic, and cultural impacts of the Proposed Action and alternatives), and references;
- Chapter 19: Best Management Practices and Mitigation Measures;
- Chapter 20: Comparison of Alternatives;
- Chapter 21: Cumulative Impacts;
- Chapter 22: Other Required Analysis;
- Chapter 23: List of Preparers and Contributors;
- Chapter 24: Distribution List;
- Chapter 25: Glossary; and
- Appendices.

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2. DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

In accordance with NEPA, FirstNet must examine a range of reasonable alternatives to design, construct, and operate the NPSBN. These alternatives must be reasonable ways in which FirstNet could meet the purpose and need for the Proposed Action. In addition to the range of reasonable alternatives, this document also describes those alternatives considered but not carried forward for analysis. Alternatives not carried forward were initially considered but found to not reasonably meet the purpose and need. FirstNet is also required to “include the alternative of no action” as part of the alternatives analysis in the PEIS. The “No Action Alternative” describes what would happen if FirstNet did not construct the NPSBN, and is used as a baseline against which the potential impacts of the action alternatives can be compared.

2.1. PROPOSED ACTION

The Proposed Action would encompass the design, deployment/construction, operation, and maintenance of the NPSBN by FirstNet or a partner organization(s) through a comprehensive network procurement process, currently underway. FirstNet anticipates a competitive process to procure a comprehensive technical and business solution to meet its stated mission and objectives. By statute, the network must have several characteristics, including security, resiliency, backwards compatibility with existing commercial networks, integration with public safety answering points (PSAPs)[1] or their equivalents, and substantial rural coverage; it must be built to open, non-proprietary, commercially available standards; and it must use existing infrastructure to the maximum extent economically desirable. The FirstNet network would have two components, the core network, and the radio access network (RAN). The core network is a key component for ensuring that users have a single interoperable platform nationwide, and would consist of a wide range of telecommunications infrastructure including fiber optic cable, towers, data centers, microwave technology, and others. The core has six primary functions: it switches data, processes and reformats information, stores and maintains data, and keeps it secure. The core network would interface with local, tribal, state, and federal networks, including 911 and the Internet, thereby serving as the backbone connecting the 50 states, 5 territories, and the District of Columbia. The core network would be constructed and maintained to the most up-to-date technological standards, composed of all standard Evolved Packet Core (EPC) elements under the 3rd Generation Partnership Project (3GPP). The EPC is the collection of systems that manages the connection of all voice calls, data sessions, messaging, and video services in a wireless network. Since the EPC is responsible for the management of all services, it is the central “brain” of the network. The RAN would consist of all radio base station infrastructure that would connect user devices. This infrastructure would include communication towers, cell site equipment, antennas, deployable mobile hotspots, and backhaul equipment required to enable wireless communications with devices using the public safety broadband spectrum. Finally, the Act states that FirstNet must continue to maintain and improve the NPSBN to account for new and evolving technologies.

[1] Public safety answering points (PSAPs) are call centers responsible for answering calls to an emergency telephone number for police, fire, and emergency medical services.

FirstNet may enter into Spectrum Manager Lease Agreements (SMLAs) with states that opt out of the FirstNet network. The range of methods that would be employed by states to connect their RAN to the FirstNet core network are expected to include methods described and analyzed in the various alternatives listed below.

2.1.1. Characteristics of the NPSBN

The Act specifies that the FirstNet network would be based on the minimum technical requirements on the commercial standards for Long-Term Evolution (LTE) service. LTE is a proven upgradeable technology, now in its fourth generation (4G). Improvements in speed and function are achieved with each subsequent generation, and 4G LTE standards are continuing to evolve. FirstNet is involved in the research and development of new standards and is working closely with the public safety community as part of this process, with the goal of ensuring that the unique needs of public safety can be met.

The core network would have six primary functions: it would switch data, process and reformat information, store and maintain data, and keep that data secure. Other functions, such as applications, services, and operational and business support systems would also be part of the core network. The backhaul, or intermediate links that carry user traffic, including voice, data, and video, and signaling from radio base stations to the core network, would likely be accomplished through fiber optic and microwave technology, with an emphasis on redundancy to allow the network to continue to function in events of extreme demand.

The RAN would place an emphasis on reliability, prioritizing physical hardening and security. Redundant power backup, redundant backhaul capabilities, structural hardening, and security measures would be implemented as appropriate to provide a resilient and reliable radio base station infrastructure.

2.1.2. Proposed Action Infrastructure

There is currently a wide range of technologies that FirstNet may use to implement and deploy the NPSBN, ranging from fixed assets to mobile, deployable infrastructure. The following are general descriptions of the types of wired, wireless, and deployable projects that FirstNet may consider.

2.1.2.1. Wired Projects

New Build – Buried Fiber Optic Plant

The installation of fiber optic cable would generally consist of plowing or trenching cable alongside the road, usually in utility corridors or within public road right-of-way (ROW), where possible. ROWs could also include utility corridors or other easements and may be public or private. This could involve either burying both conduit and cable inside the conduit or only direct buried cable. Installation may involve plowing, trenching (including vibratory plowing), or directional boring, and may involve the construction of points of presence (POPs)[2], huts, or other facilities to house outside plant equipment or hand-holes to access the fiber.

Use of Existing Conduit – New Buried Fiber Optic Plant

The installation of new fiber optic cable in existing conduit typically requires blowing or pulling new fiber optic cable into existing, buried conduit. In this project scenario, any ground disturbance would usually be limited to the entry and exit points of the existing conduit.

New Build – Aerial Fiber Optic Plant

Construction of new aerial fiber optic cable would generally consist of installing new poles and hanging cables in previously disturbed or new (undisturbed) ROWs or easements, or installing replacement poles in previously disturbed ROWs or easements. Installation of new poles and fiber may involve construction of access roads, depending on the availability of ROWs. This type of activity may also involve the constructions of POPs, huts, or other facilities to house outside plant equipment.

Collocation on Existing Aerial Fiber Optic Plant

Installation of new fiber on existing poles may require structural hardening or reinforcement to improve disaster resistance and resiliency. It may also require pole replacement to accommodate an increased load from new users. All replacement poles must be placed in the exact same hole in order for the action to qualify as "collocation."

Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable

This project type would involve lighting up dark fiber owned by and leased from various providers. Dark fiber is fiber that has been installed without a transmitter and receiver, typically to provide capacity for future growth.

New Build – Submarine Fiber Optic Plant

Deployment of new submarine cable, if implemented, would involve the installation of specially sealed cables in limited near-shore or inland bodies of water, and construction of landings/ facilities on the shore to accept a cable, which is typically buried close to shore. Transoceanic submarine cables are not anticipated to be used as part of the Proposed Action; therefore, submarine repeaters and large marine vessels for installation or repairs would not be used. However, small marine vessels could be required for installation and repairs of smaller, non-transoceanic cables in limited near-shore or inland bodies of water.

Installation of Optical Transmission or Centralized Transmission Equipment

All fiber installation activities may require additional installation of equipment to enhance the digital signals travelling through the fiber, depending on the network configuration. FirstNet may also install transmission equipment as part of the core network construction. This

[2] Points of presence are connections or access points between two different networks, or different components of one network.

equipment is usually installed in small boxes or huts in the ROW of the utility corridor and may involve construction of access roads, depending on the availability of public ROW.

2.1.2.2. Wireless Projects

New Wireless Communication Towers

FirstNet may undertake the construction of new towers of various heights and configurations (e.g., monopoles, lattice, and guy-wired) to support wireless infrastructure, such as antennas and microwave dishes. Tower construction may also include associated structures including generators, equipment sheds, fencing, security lighting, aviation lighting, electrical feeds, and concrete foundations and pads. This type of project may require the construction of access roads, depending on the availability of public ROW.

Collocation on Existing Wireless Tower, Structure, or Building

Collocation projects would involve mounting or installation of equipment such as antennas or microwave dishes on an existing tower to transmit and/or receive signals, or provide backhaul. Installation of power units, such as an uninterruptible power supply could be added. Existing towers, structures, or buildings may require structural hardening or increased physical security measures.

2.1.2.3. Deployable Technologies

As part of the Proposed Action, there may be areas where permanent, fixed infrastructure cannot be erected due to a variety of factors. Deployable technologies may provide an option to either provide coverage in such areas, or they may be used to supplement existing coverage during a large-scale planned or emergency event. In addition, deployable technologies could also be used in areas where potential permanent impacts to significant sensitive resources/receptors cannot be avoided or mitigated. In general, some limited construction could be associated with the implementation of deployable technologies, such as land clearing or paving for parking or staging areas.

Cell on Wheels

The Cell on Wheels (COW) deployable technology consists of a cellular base station on a trailer with an expandable antenna mast, typically between 15 feet to 40 feet in height, and usually a microwave or satellite link back to the main controller. COWs typically contain a small generator and may also connect to utility power cables. This type of technology is designed to be part of a cellular network and augment existing capacity.

Cell on Light Truck

The Cell on Light Truck (COLT) deployable technology consists of a cellular base station on a light truck platform with an expandable antenna mast, typically between 15 feet and 40 feet in height, and usually a microwave or satellite link back to the main controller. COLTs typically contain a small generator and may also connect to utility power cables. This type of technology is designed to be part of a cellular network and augment existing capacity.

System on Wheels

The System on Wheels (SOW) deployable technology consists of a full base station and controller on a large towable trailer or truck. A SOW is a fully self-contained cellular system that can provide an island system with no need for satellite/microwave link back. SOWs typically contain a power generator and a larger antenna mast (ranging from approximately 50 feet to 120 feet in height), suitable to address larger localized coverage or capacity shortages in the event of planned or unplanned incidents.

Deployable Aerial Communications Architecture

Deployable Aerial Communications Architecture (DACA) consists of aerial vehicles, including, but not limited to, drones, balloons, blimps, and piloted aircraft, which would be deployed at a variety of altitudes and are capable of providing wide-area coverage, although with relatively low capacity/throughput. DACAs would be used for addressing wide-scale loss of coverage after a major catastrophic event, which would have the network down for a significant period.

2.1.2.4. Satellites and Other Technologies

Satellite-Enabled Devices and Equipment

FirstNet may install permanent equipment on existing structures or support the use of portable devices that use satellite technology, such as satellite phones or video cameras.

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 and may work with other federal agencies or commercial entities that engage in satellite launches to use Global Positioning System satellites to support devices requiring location information.

2.2. Description of Alternatives

In accordance with NEPA, FirstNet has considered a variety of alternatives to ensure the building, deployment/construction, operation, and maintenance of the NPSBN. CEQ has defined reasonable alternatives as those that are economically and technically feasible ways to meet the purpose and need. NEPA also requires the analysis of the No Action Alternative, which provides a baseline against which the potential impacts of the Action Alternatives may be compared. FirstNet is carrying two alternatives plus the No Action Alternative forward for analysis. Furthermore, FirstNet has considered three additional alternatives and dismissed them from further consideration.

2.2.1. Preferred Alternative

Under the Preferred Alternative, FirstNet and its partner(s) would construct a nationwide broadband LTE network using a combination wired, wireless, deployable, and satellite technologies. This may include, but is not limited to, the following methods: collocation of the network equipment on existing towers, poles, and structures; construction of new communication towers, poles, and associated structures to include generators, equipment sheds, fencing, and concrete pads; use of existing fiber facilities, including lighting up dark fiber and installation of new fiber on existing poles and in existing conduit; installation of new conduit and fiber using trenching (including vibratory plowing) or directional boring (including horizontal directional drilling); deployment of satellite phones and other portable satellite technology; installation of microwave facilities for cell-site backhaul communication; and the utilization of deployable technologies.

2.2.2. Deployable Technologies Alternative

Under the Deployable Technologies Alternative, FirstNet would procure, deploy, and maintain a nationwide fleet of mobile communications systems, including ground-based and aerial deployable technologies, to provide temporary coverage in areas not covered by existing, usable infrastructure, as there would be no collocation of equipment or new construction associated with the wired or wireless projects discussed above under the Preferred Alternative. Generally, these units would be deployed at times of an incident to the affected area for either planned or unplanned incidents or events. Equipment would be stationed in every state and territory, often at multiple locations in each state or territory, to facilitate suitable response. These mobile communication units would be temporarily installed and may use existing satellite, microwave, or radio systems for backhaul. In general, some limited construction could be associated with the implementation of deployable technologies, such as land clearing or paving for parking or staging areas. However, these construction activities would be minimal in comparison to the combination of project types associated with the Preferred Alternative, as described above.

2.2.3. No Action Alternative

Under the No Action Alternative, the NPSBN would not be constructed; there would be no nationwide coordinated system dedicated to public safety interoperable communications. The existing multiplicity of communications networks would remain in place, as would the current, known limitations and problems of existing communication networks during times of emergency or disaster. This alternative would require an act of Congress to revise the Act, which currently requires the NPSBN.

2.3. Alternatives Considered But Not Carried Forward

During the course of the development of the Proposed Action, several additional alternatives to implement the Proposed Action were considered. Each of these alternatives was found deficient in some way and did not meet the purpose and need for the Proposed Action, as discussed below.

2.3.1. New Construction Only Alternative

Under the New Construction Only Alternative, FirstNet would construct a nationwide network using all new construction and installation of fiber optic cable, conduit, utility poles, communication towers, and installed equipment. This alternative has been dismissed from further consideration because it is counter to FirstNet’s legislative mandate to leverage existing infrastructure. Furthermore, new construction of the entire network would be cost-prohibitive and the construction timeline would cause unnecessary delays in network implementation as a result of the need for building an entirely new NPSBN from the ground up, which would not meet the agency's legislative purpose and the needs of the Proposed Action.

2.3.2. New Satellite Alternative

Under the New Satellite Alternative, FirstNet would construct a nationwide network using new and existing satellite technology only. Generally, satellite technology is not cost effective due to limited spectrum and technical issues, such as limited in-building coverage and performance. This alternative has been dismissed from further consideration because it is counter to FirstNet's mandate to use standards-based LTE technology to provide coverage, and its performance capabilities would not meet the purpose and need of the Proposed Action.

2.3.3. Collocation-Only Alternative

Under the Collocation-Only Alternative, FirstNet would construct the NPSBN using existing infrastructure only, by collocating equipment exclusively on existing towers, buildings, or other structures. This alternative has been dismissed from further consideration because suitable infrastructure does not exist to provide nationwide broadband coverage using only existing infrastructure. Many areas of the country, particularly rural areas, would have little to no service options from FirstNet if existing infrastructure alone were required to build the network. Therefore, this alternative would not meet the purpose and need of the Proposed Action.

2.4. Analysis of the Science Evaluating and the Regulatory Framework Governing the Potential Effects of Radiofrequency (RF) Emissions Exposure on Humans and Animal and Plant Species

General interest in the topic of the safety of radiofrequency electromagnetic field emissions (RF emissions),[3] a form of radiation, from communication towers and their relationship to human health and the environment has increased with the number of devices being used and the degree of connectivity needed for people to go about their daily lives. This interest has been demonstrated in the comments received by FirstNet for its PEIS for the NPSBN (or "project"), other telecommunications projects, as well as active discussions within the human health and environmental science communities, and among the general public. Accordingly, FirstNet has determined it is important to analyze the potential human and environmental effects for the PEIS.

This document provides a general overview regarding (RF) emissions, the existing regulatory framework for limiting RF exposures, the general discussions on the current state of research for potential effects on humans, as well as information on animal and plant species, and some of the general conclusions on data gaps and the paths forward. While this document is not intended to be a complete analysis of all aspects of RF emissions and their potential effects, it does provide a

[3] RF emissions refer to RF radiation emitted by devices. OSHA defines RF radiation as "electromagnetic radiation in the frequency ranges 3 kilohertz (kHz) - 300 Megahertz (MHz), and 300 MHz - 300 gigahertz (GHz), respectively" (OSHA, 2016)

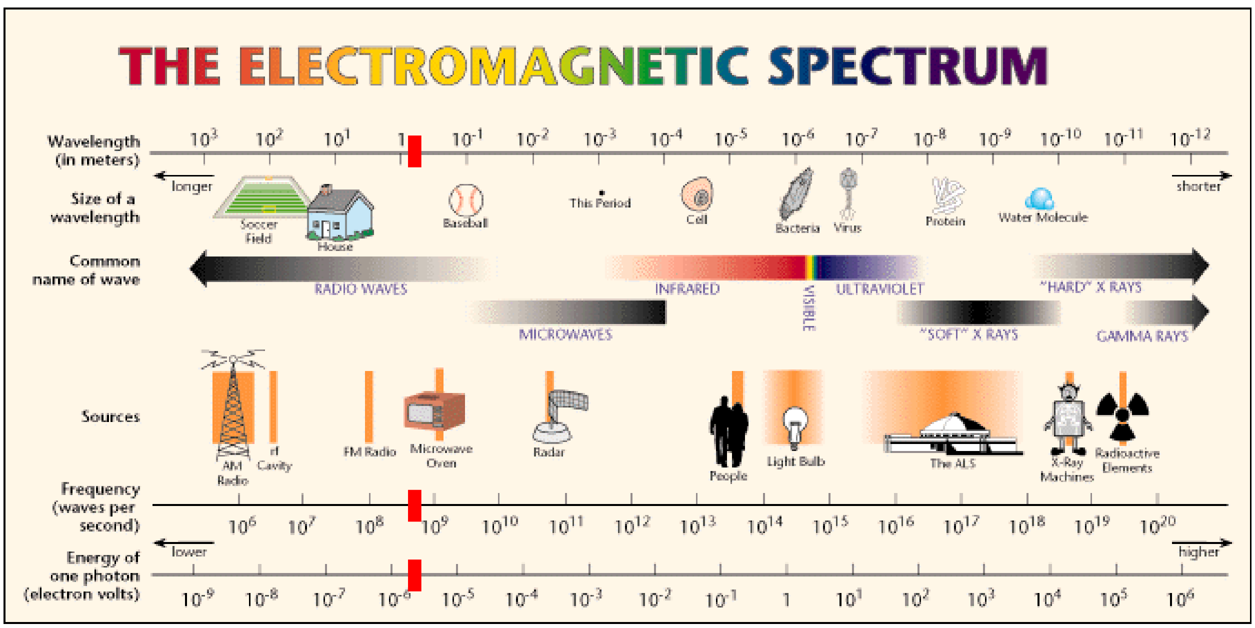
general discussion of some of the credible scientific literature and information that relates to RF emissions and potential effects to human health and other species.

In general, radiation is the product of a wide range of energies that form the electromagnetic spectrum. A number of radiation sources exist in nature (such as the radon emitted from the breakdown of certain minerals in the ground or the radiation from energy in space) and others are artificial (such as RF emissions created by broadcasting, radio, and cellular equipment).

The electromagnetic spectrum is divided into two main classes: non-ionizing radiation (NIR) and ionizing radiation (IR):

- **Non-ionizing radiation**. NIR is at the low end of the electromagnetic spectrum. Visible Light, AM/FM radio, cellular, and microwaves are all classified as NIR. FirstNet system would operate in the 700 MHz frequency band, which means that it would emit NIR (Zamanian, 2005).
- **Ionizing radiation**. IR can produce charged particles (ions) in matter and is produced by unstable atoms that have an excess of energy or mass or both. Gamma radiation and x-rays are examples of IR. FirstNet equipment would not produce any IR (Zamanian, 2005).

This review focuses on NIR related to cellular systems (e.g., tower and building-mounted equipment) and, specifically, the 700 MHz LTE spectrum band licensed for use by FirstNet. Figure 2.3.3-1 details the full electromagnetic spectrum (U.S. Department of Energy, 2009). The red band on each line of Figure 2.3.3-1 indicates the 700 MHz frequency band.



Source: (U.S. Department of Energy, 2009)

Figure 2.3.3-1: The Electromagnetic Spectrum

Radiation is frequently presented in the terms of *power intensity* or *irradiance*. The power intensity is the radiant flux[4] received by a specific surface area. The units for irradiance are watts per meters squared (W/m^2). Frequently, RF emissions and exposure standards are defined in terms of power density. Some standards are explicitly defined while others are a function of the frequency of the radiation. Table 2.4.2-1 summarizes the current Federal Communications Commission (FCC) standards for RF emissions for occupational/controlled exposure, as well as uncontrolled exposure.

Since FirstNet is licensed to operate in the 700 MHz range,[5] the FCC regulations establishing exposure limits would govern FirstNet operations and (power density) would be between 2.33 mW/cm^2 and 2.66 mW/cm^2 for occupational or controlled exposure for frequencies of 700 and 799 MHz, respectively.[6] For these same frequencies and general population/uncontrolled exposure, the FCC standard exposure limits are 0.47 mW/cm^2 to 0.53 mW/cm^2. This analysis is intended to outline some preliminary information on the topic in order to describe the state of current research, science, and the unsettled issues surrounding RF emissions that better aid FirstNet in making its decisions.

2.4.1. RF Emissions and Humans

For 20 years, the regulatory levels for human exposure to RF emissions have been established by the FCC as a means of protecting both workers and the general public from any potential effects.[7] Concerns about RF emissions have been raised for a number of years by various nongovernmental stakeholder groups about whether the FCC's exposure levels—and similar standards established by other developed nations—are protective enough based upon the current science on the potential health effects.

The FCC's standards were first established in 1996 based upon the guidelines formulated by the National Council on Radiation Protection and Measurements (NCRP), a Congressionally-chartered nonprofit corporation that prepares recommendations on matters of radiation protection, as well as those promoted by two independent nonprofit organizations, the Institute of Electrical and Electronic Engineers (IEEE) and the American National Standards Institute (ANSI), both of whom have helped set industry standards for decades (FCC, 2013) (FCC, 2014).

These standards set effective radiated power (ERP) of no more than 500 watts per channel (WPC), depending on tower height and the total number of radio channels (transmitters) authorized at a specific site, so that the RF power transmitting at any particular location will vary, with most urban and suburban sites operating at an ERP of less than 100 WPC (FCC, 2014).

According to the FCC and depending upon the type of antenna being used, the typical cell site emits an ERP of 100 WPC which corresponds to an actual radiated power of 5-10 watts (FCC, 2014). Measurements taken of typical ground-level exposures are usually well-below the FCC

[4] The radiant flux is the amount of energy per unit time radiated from a source.
[5] FirstNet holds a single 700 MHz Public Safety Broadband Nationwide License, under Call Sign WQQE234.
[6] See 47 U.S.C. § 1421(a).
[7] See 47 CFR 1.1307(b), 1.1310, 2.1091, 2.1093.

exposure standards, because the power of RF emissions rapidly decrease as the distance from the transmitter increases (FCC, 2014).

Demonstrating cause and effect in humans from low-level[8] environmental exposures is considered to generally require multiple studies over many years before consensus is reached and a clear cause and effect can be established (Webb, P. and C. Bain, 2011). In order to respond to a request by Congress to study the potential health effects of electric and magnetic fields on humans and other living organisms, the Department of Energy entered into an agreement with the National Research Council (NRC) for the National Academy of Science to prepare a study.

That report, in looking at routine exposures to electric and magnetic fields found in homes and communities as the cause of disease and abnormalities, stated, "There is no widely accepted understanding of how extremely low-frequency electric and magnetic fields, such as those associated with the distribution and use of electric power, could cause a disease or whether it causes a disease. Considerable research has been conducted in this area, and numerous research data can be found on the subject, but given the lack of a specific disease end point to track or a well-accepted theory of how the fields might affect biologic systems, the data are discordant; they have been gathered using different exposure conditions and have resulted in conflicting observations of different effects or no effects" (National Research Council, 1997). Hence, the investigations into RF have not yet achieved scientific consensus on cause and effect.

Some of the major problems with demonstrating cause and effect for RF are listed below:

- No consistent measures of exposure. Exposure is changing with the proliferation of cell phone use, and there is no real unexposed or "control" population (Ahlbom et al., 2004) (Khurana et al., 2010);
- No scientifically agreed upon biological mechanism for harm. The lack of a clear biological mechanism increases uncertainty into whether the health end point that the study examined is the correct endpoint to try and measure (Hauri et al., 2014) (Ahlbom et al., 2004); and,
- Some potential effects of major concern are rare, such as brain cancer and acoustic neuroma, both of which have been potentially linked to RF exposure. If the health outcome is rare, it is even harder to demonstrate cause and effect (Ahlbom et al., 2004).

However, there is an active scientific research effort worldwide concerning the potential health effects of RF emissions, with new studies being published frequently. This research environment reflects the public interest in the topic, the increased level of interest within the scientific community, and the desire by governments and health organizations to determine conclusively whether there are any potential effects from RF emissions to either people or the environment.

[8] For the purposes of this review, "low-level" is a qualitative description of the small amount of energy contained in these emissions.

2.4.2. Regulatory Framework for RF Emissions

As indicated above, RF emissions have been identified by the FCC as a potential environmental factor to be weighed in evaluating a transmitter's effect on the human environment. Currently, the FCC implements and enforces both occupational and public exposure limits to RF electromagnetic fields through its authorization and licensing process. In order for a facility operation or transmitter to be authorized or licensed, FCC requires licensees to be in compliance with its regulations relating to RF emissions.

In 1996, as a consequence of the authority granted by Congress to the FCC in the Telecommunications Act of 1996 (TCA) to "prescribe and make effective rules regarding the environmental effects of radio frequency emissions" (TCA, 104 Pub. L. 104), the agency adopted new guidelines and procedures reflected in its revised Office of Engineering and Technology (OET) Bulletin 65, *Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields*, originally issued in 1985 (FCC, 1997). The revised guidelines include limits for Maximum Permissible Exposure (MPE) for transmitters operating between 300k Hz and 100 GHz which are averaged over a specified time-interval. The limits are different based on whether an occupational setting or a general population exposure setting is being evaluated. These standards have been challenged in federal courts and have been upheld (*See*, for example, *Cellular Phone Taskforce et al. v. FCC*, 205 F.3d 82 (2nd Cir. 2000)).

The FCC has updated its standards for evaluating mobile or personal communication device "localized absorption" as well. The FCC's MPE "localized absorption" limits are based on recommendations from the NCRP and the (IEEE [9] and were adopted by the ANSI to replace the earlier ANSI guidelines of 1982. These limits are based on thermal effects (i.e., the amount of RF energy required to heat tissue). According to the FCC, the established limits are well below levels that are considered to have adverse health effects. These levels are shown in Table 2.4.2-1 below. Additionally, the IEEE's Committee on Man and Radiation (COMAR) states that the amount of RF emissions in buildings "will be lower than outside, since a substantial fraction of the signal is absorbed when it passes through most building materials" (IEEE COMAR, 2000).

COMAR cites a study (Petersen et al., 1997) that measured the power density of radiation on the top floors of buildings with roof-mounted antennas (IEEE COMAR, 2000). The study found that radiation emissions on these floors "were less than 0.0004 mW/cm^2 per 100 W Effective Radiated Power (ERP) per channel." For purposes of reference, this indicates that it is 1,000 times less than the FCC standard for general population exposure and 5,000 times less than the FCC standard for occupational workers.

COMAR also found that "roof-mounted base station antennas are normally designed to radiate energy in the horizontal direction away from the building, and they radiate very little energy into the building itself. Therefore, exposure to residents inside a building with roof-mounted base station antennas is invariably very low" (IEEE COMAR, 2000).

[9] Outside of the United States, many countries (including most of Europe) use exposure guidelines developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP safety limits are similar to those of the NCRP and IEEE (Classic, K. 2015).

In March of 2013, the FCC voted to review current RF rules and regulations and put forth a *Notice of Inquiry*. The *Inquiry* was intended to open discussion around whether the existing RF exposure limits and policies need to be reassessed. Through this process, the FCC has gathered input from industry, scientific experts, and members of the public to help the agency to determine whether current policies and rules need to be changed (FCC, 2013).

Table 2.4.2-1: FCC Regulatory Levels

Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm^2)**	**Averaging Time $(E)^2$, $(H)^2$, or S (minutes)**
Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	$(900/f^{2)*}$	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
Limits for Occupational/Controlled Exposure				
0.3-1.34	614	1.63	(100)*	30
1.34-30	842/f	2.19/f	$(180/f^{2)*}$	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

Source: (FCC, 1996)
f=frequency in MHz
*Plane-wave equivalent power density

2.4.3. Overview of Research for Potential Non-Thermal Effects to Humans

A few organizations have provided research that is useful as a framework for the state of the research on RF and the basis of some of the concerns. For example, several studies of the potential non-thermal health effects cited below have focused on cancer outcomes (primarily childhood leukemia and brain cancers); however, reproductive/neonatal problems, neurological and neurobehavioral issues, and genotoxicity have also been studied. In addition to these studies, one group (the International Association of Fire Fighters) has raised concerns about potential non-thermal effects resulting from RF emissions coming from telecommunications equipment (International Association of Fire Fighters, 2015).

As with any source, RF emissions from the FirstNet system would be dependent on the location, type, and power of antennas used. There are three basic forms of antennas: omnidirectional, narrow horizontal gain (focused beam), and panel.

The most common type of antenna is a panel antenna, as these are easily mounted on towers or rooftops and provide approximately 60 degrees of horizontal and vertical coverage. Omnidirectional antennas are frequently used for things such as Wi-Fi where a widespread area needs to be covered by a signal. Directional beam antennas are used to propagate a strong, focused beam to a specific location which is ideal for sending a stronger signal for greater distances without affecting areas outside the target. Thus, the omnidirectional and beam antennas are generally not suitable for deploying a cellular network.

Panel antennas do not produce a significant amount of radiation outside of the primary lobe, making them an ideal candidate for providing widespread coverage while maintaining control of the radiation beam. Figure 2.4.3-1 shows a typical lattice cell tower with multiple panel antennas arranged radially.

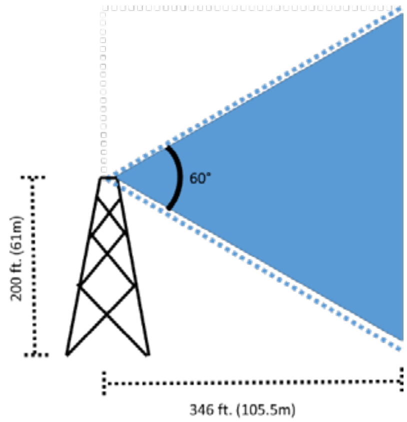
Source: (Connecticut Department of Public Health, 2015)

Figure 2.4.3-1: Monopole Cell Tower with Multiple Panel Antennas

Using the power intensity formula described above and assuming an antenna fixed to a base station transmits 60 watts (W) of power:

- The power density 0.30 m (1 feet) from the base station would be 4.77 W/m^2;
- The power density 0.61 m (2 feet) from the base station drops to 1.2 W/m^2; and
- At 100 m, the power intensity drops to 0.000477 W/m^2, a 99.99 percent reduction.

Figure 2.4.3-2 depicts the radiation beam from a panel antenna on a 200 feet (61 m) tower. Assuming a 60-degree vertical spread and no vertical tilt, the primary lobe of the radiation beam (shaded blue) would not reach the ground until 346 feet (106 m) from the tower. At the point where the beam reaches the ground (approximately 346 feet [106 m] from the base), there is a 99.99 percent reduction in power density compared to the power intensity 0.30 feet (1 m) from the panel.



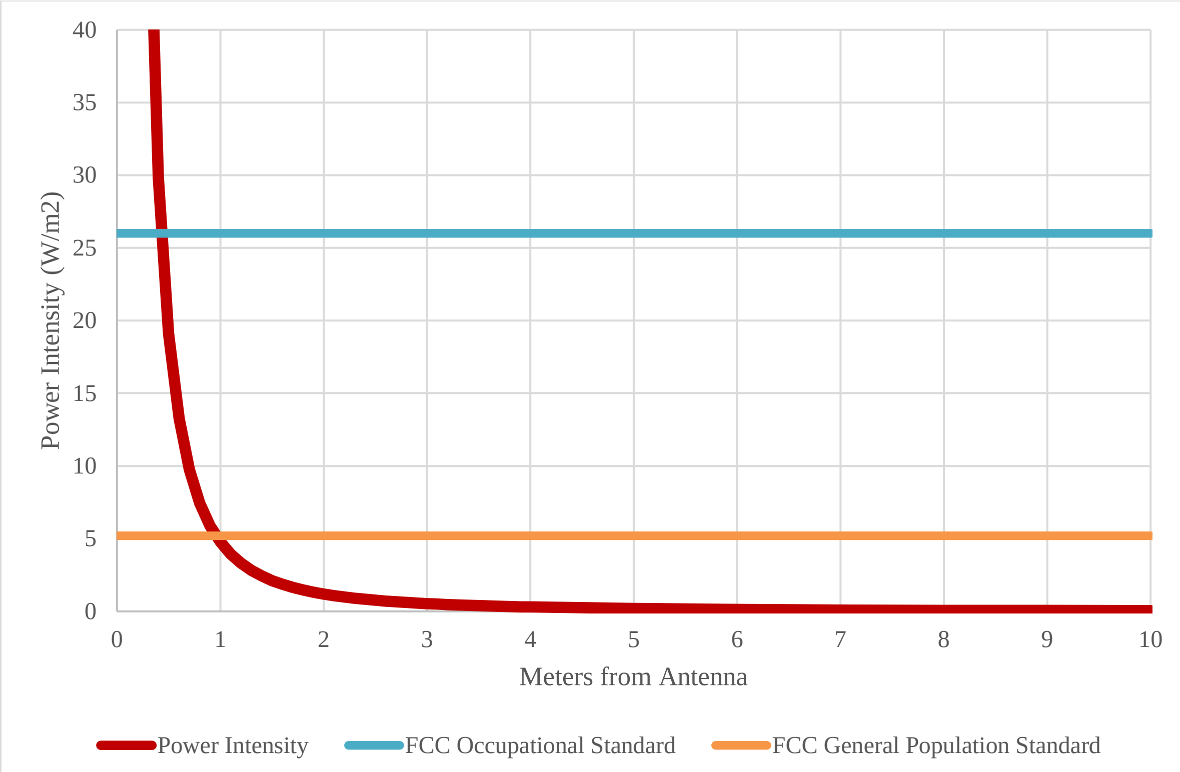
Source: (FCC, 1997)

Figure 2.4.3-2: Depection of Primary Radiation Lobe of a Panel Antenna Attached to a 200 feet (61 m) Cell Tower

Correspondingly in Figure 2.4.3-2, the zone outside of the blue-shaded area is not within the primary radiation lobe of the antenna, and thus, would receive very little radiation (<0.01 percent of the density 0.30 m [1 feet] in front of the antenna). This means that buildings and people under the tower would receive little RF emissions from those antennas, assuming none of the antennas are tilted downward.

Figure 2.4.3-3 depicts the decrease of power intensity from a 60W antenna as a function of distance from the antenna and displays the FCC standards for 780 MHz frequency. The 780 MHz frequency is used for these calculations since it splits the two operating frequency bands the FirstNet system would operate at (i.e., 758-769 MHz and 788-799 MHz). While the FirstNet system would not operate specifically at 780 MHz, this frequency best represents all of the possible frequencies at which the system would operate.

Figure 2.4.3-3 further demonstrates that the FCC occupational standard is met at 0.42 m while the standard for the general public is met at 0.96 m. While these distances may seem small and insignificant, this chart only represents one 60W antenna. Generally speaking, there may be three or more antennas serving one area (1 transmitter, 2 receivers). Assuming there are three antennas operating at a power of 60W at 780 MHz each, the standards are then met at 0.72 m and 1.66 m, respectively using the formulas in Table 2.4.2-1.



Note: This figure is a simple representation of the power intensity versus distance from a 60W antenna. There are many other factors that may affect the power intensity at a specific location, which are not accounted for in this graph. Some factors include positive or negative interference with other electromagnetic waves, absorption by building materials or other items, and varying power outputs dependent on signal demand.
Source: (FCC, 1997)

Figure 2.4.3-3: 60W Antenna (780MHz) - Power Intensity vs Distance with Respect to FCC Guidelines for Limiting Thermal Radiation

As previously described, radiation can elicit both thermal and non-thermal effects in humans and other biological organisms. Given that thermal effects are only elicited when exposed to intense amounts of radiation, this section summaries the available credible scientific information about potential non-thermal effects of RF emissions, particularly at low power intensities.

Among the research organizations studying RF emissions, the World Health Organization (WHO)—as an agency of the United Nations—is the most prominent. According to the WHO, there have been tens of thousands of papers published on RF, extremely low frequency (ELF) and potentially related health effects over the last 30 years. A recent (May 2015) statement on the WHO website states:

> *The heating effect of radio waves forms the underlying basis for current guidelines. Scientists are also investigating the possibility that effects below the threshold level for body heating occur as a result of long-term exposure. To date, no adverse health effects from low level, long-term exposure to radiofrequency or power frequency fields have been confirmed, but scientists are actively continuing to research this area* (World Health Organization, 2015).

In 2011, based upon the inconclusive data and in an abundance of caution, WHO classified RF exposures due to cell phone use as a 2B carcinogen—indicating that it was possibly carcinogenic to humans—based upon some studies that found a potential increased risk of glioma (a type of brain cancer) associated with cell phone use (International Agency for Research on Cancer, 2011). However, WHO's International Agency for Research on Cancer (IARC) noted that the evidence for carcinogenicity for occupational and environmental exposures (exposures to emissions from cell towers would fall into the "environmental" category) was inadequate to draw conclusions regarding carcinogenic potential.

The conclusions made by the IARC specifically identify RF emissions from wireless phones as the source for positive associations with negative health effects. Many of the studies examined by the IARC for fixed transmitter emissions sued that living close to fixed transmitters increased the risk of developing either brain cancer, leukemia, or lymphoma; nonetheless, the IARC identified several shortcomings of these studies, including:

- Not accounting for mobile phone use or exposure to RF emissions from other sources (ambient RF emissions levels or confounding factors);
- Not accounting for buildings or other geographic features which impact the strength of the radiation;
- Small population size;
- Lack of controls;
- Poor exposure assessment (no individual data);
- Non-differential disease misclassification; and
- Lack of cumulative measure of exposure to RF emissions (take into account individual's place of residence between birth and diagnosis of cancer/disease) (International Agency for Research on Cancer, 2013).

While some of the studies indicated a positive correlation between distance from transmitters and risk of cancer, the caveats identified by the IARC indicate general lack of scientific rigor of previous research projects. Furthermore, most of the studies reviewed by the IARC focus on cellular telephone use rather than low-level, background radiation emitted from fixed transmitter sites. Overall, these studies do not indicate a clear trend, reproducible with regard to the effects of fixed transmitter radiation.

WHO is currently undertaking a health risk assessment of RF electromagnetic fields, to be published as a monograph in the Environmental Health Criteria Series. WHO scientists themselves began conducting research on RF emissions, and electromagnetic fields more broadly, when it established the International EMF Project in 1996 (Repacholi, M., 2001). However, recent studies on behalf of WHO have concluded that "there is insufficient data to draw firm conclusions about health effects from long-term low-level exposure [to RF electromagnetic fields] typically occurring in the everyday environment" (Roosli et al., 2010).

In contrast to the WHO's statement on health effects, a public advocacy group of scientists, known as the BioInitiative Working Group (BWG), published the BioInitiative Report, first in 2007 and followed by a revised version in 2012 (Sage, C. and D. Carpenter, eds., 2012), that found substantial evidence of adverse health effects associated with RF and ELF exposures.

However, the BWG itself has been criticized by other scientific, professional, and governmental bodies for ignoring conflicting, inconsistent, or other credible evidence that clashed with its report (e.g., (Dolan, M. and J. Rowley, 2009)).

The BWG report concluded that there was evidence to support adverse health effects resulting from sustained low-intensity electromagnetic radiation on decreased male fertility, fetal and neonatal effects, brain tumors, childhood leukemia, genotoxicity, and several other effects. The BioInitiative Report noted further that health effects due to emissions from cell towers were cited in a number of studies that possibly linked headaches/sleep disturbance/ concentration issues in children, adolescents, and adults at levels in the range of 0.003 to 0.05 $\mu gW/cm^2$, much lower than current regulatory standards shown on Table 2.4.2-1. BWG recommends lower standards be established and that cell phone towers not be built within certain distances of sensitive receptors, such as schools, daycare centers, and hospitals (Sage, C. and D. Carpenter, eds., 2012).

These two positions illustrate the scientific and philosophical divide. First, there is some evidence of adverse health effects at levels below the current standards in a number of studies, but as is the case with other epidemiological studies attempting to prove causality, these studies are subject to a variety of uncertainties inherent in the epidemiological process.[10] Consequently, it appears that the preponderance of the evidence to date does not definitively demonstrate that there are adverse health effects caused by RF emissions and there is still no single, plausible biological mechanism to indicate adverse effects. Second, although there is some scientific data in certain studies to warrant further investigation, some researchers urge that the precautionary principle should apply to reduce exposures as much as possible (Sage, C. and D. Carpenter, eds., 2012).

2.4.4. RF Emissions and Non-Human Species

Unlike those established for human exposure, no federal regulatory levels have been set for non-human species exposure to RF emissions. This is partly due to the nature of how environmental assessment is conducted under NEPA and how the mechanisms for potential environmental effects are enforced under that statute, as well as with other federal environmental laws and regulations.

Under NEPA, an environmental analysis is required to be conducted by the lead federal agency prior to undertaking any major federal action. This analysis requires the federal agency to consider any and all types of environmental impacts associated with the project and make qualitative decisions concerning the likelihood and severity of the potential effects and give potential environmental effects parity with engineering and economic decisions.

As is the case with considering the potential effects of RF emissions on humans, demonstrating cause and effect in animal and plant species from low-level environmental exposures is equally—if not more— challenging and it too requires multiple studies over many years and across many species. Although there is some research that shows that there could be potential

[10] It is difficult to attribute causation when other effects cannot be ruled out. The complexity of health conditions also makes it difficult to imply causation. Epidemiological studies can never provide proof or 100 percent certainty of an effect (Webb and Bain 2011).

effects on some animal species associated with RF emissions, here too there is no clear or definitive scientific research and literature, especially for animals or plants in North America, to achieve scientific consensus on whether there exists demonstrable cause and effect.

Undoubtedly, there is considerable public interest into the potential effects of RF emissions on both humans and other species. Research is continuing with a number of scientific and academic centers, although there is still no consensus within the larger scientific community. Consequently, there is still the need for more targeted information, research, and studies on RF emissions and human, plant, and animal life. This means that we should expect that additional research will likely both continue and increase over the coming years.

2.4.5. Research on the Potential Effects to Animal and Plant Species

Since about the year 2000, a number of research studies have been conducted that focus on RF emissions and the potential effects to animal and plant species. However, general discussions of RF exposure to ground migrating and flying animal species, specifically bird species, are largely grouped as a component of broader discussions of direct and indirect effects of transmission and communication towers; many of these studies are from outside the United States (Bhattacharya, R. and R. Roy, 2013) (Bhattacharya, R. and R. Roy, 2014). Many of these studies focus on the effects to population abundance and habitat use resulting from anthropogenic features, such as tower siting and construction, as well as bird collision hazards caused by equipment siting and lighting. As a result, RF emission concerns and potential effects are used as a collective piece of information in some of these studies to discuss broader species impacts related to transmission and communication towers rather than being the focus of the study.

Mirroring the sentiments expressed by the larger environmental community, the USFWS has indicated that RF emissions could be potentially harmful to migratory birds, even at levels too low to cause thermal effects (Manville II, A., 2007) (Manville II, A., 2009) (Manville II, A., 2014).[11] Although there has been more recent discussion on the RF emission potential of communication towers in the U.S., these discussions still focus on the European research that has been carried out on RF emission effects to birds. The emphasis of the research is on two areas: impacts on avian reproduction and interruption to avian navigation.

Research conducted in Balmori (2005), Balmori and Hallborg (2007), and DiCarlo (2002) suggests that the presence of electromagnetic fields in the microwave range may be a consideration in the decline of some urban bird populations (Balmori, A., 2005) (Balmori, A. and O. Hallberg, 2007) (DiCarlo et al., 2002). Research in Balmori (2005) focused on several species of wild birds in relation to cellular tower sites in Spain and indicated negative correlations between levels of RF emissions and bird breeding, nesting, and roosting. Also, nest and site abandonment, plumage deterioration, locomotion issues, and even death were noted for some house sparrows, white storks, rock doves, magpies, collared doves, and other species that had historically been documented to roost and nest in close proximity to cellular antennas. The

[11] It should be noted that although discussions of RF emissions generally involve "biological effects," meaning terrestrial and avian species, the research and environmental community have focused largely on bird species, especially migratory.

research suggested that these symptoms were not observed prior to construction of the cellular towers.

Balmori and Hallberg (2007) reported that declines of urban house sparrows in Spain increased as electromagnetic field strength increased. A report by Everaert and Bauwens (2007) also found negative correlations between the amount of RF emissions present and the presence of male house sparrows and concluded that long-term exposure to higher emission levels may be affecting bird abundance or bird behavior in this species (Everaert, J. and D. Bauwens, 2007).

Similarly, Bhattacharya and Roy (2014) looked at bird and nest occurrence in relation to tower proximity and electromagnetic fields in India. The study examined bird species within proximity to towers and used the point count method to identify the presence of birds and nests at various distances in all four cardinal directions from towers. This study found that bird occurrence was lowest within 20 meters of towers, which is the zone where power density was at peak values. Also, it was found that within this zone food sources were readily available and avoided. Additionally, no nests were identified within this zone and the closest nest was well outside this zone (approximately 80 meters) (Bhattacharya, R. and R. Roy, 2014).

Laboratory studies conducted with domestic chicken embryos have shown that emissions at the same frequency and intensity as that used in cellular telephones have appeared to result in death (DiCarlo et al., 2002) (Manville II, A., 2007). These studies have been used to suggest that RF emissions at low levels (far below the existing exposure guidelines for humans) may be harmful to wild birds; however, given the controlled nature of the studies and potential exposure differences in the wild, this causation is left to interpretation and extrapolation. A number of other studies generally touch upon the nature of RF exposure and the disruption of biological processes that are fundamental to plant and animal growth and health, including but not limited to behavior, DNA damage, immune deficiencies, reproductive system effects, hormone dysregulation, degraded cognition and sleep, and desynchronization of neural activity (BioInitiative Working Group, 2012) (Balmori, A., 2005).

Further, it has been suggested that RF emissions may act as an attractant to certain other species of birds. Magnetite is a mineral found in high concentrations in bird eye, beak, and brain tissues and is used by birds for navigation. Since magnetite is highly sensitive to the electromagnetic frequencies, it has been suggested that RF emissions could lead to increased bird strikes and/or direct exposure to high levels of RF emissions due to the attractant quality of materials used in some equipment (Ritz, 2004) (Balmori, A., 2005). Along these same lines, Balmori (2005) has noted that other flying species that use magnetic fields for navigation purposes have been found to be affected by RF emissions, primarily honeybees and butterflies.

There are no available studies indicating that low-level RF emissions affect honeybees. After several studies were published regarding the effects of cell phones on bees, the author of one of the studies, Stefan Kimmel, "emailed *The Associated Press* to say that there is 'no link between our tiny little study and the Colony Collapse Disorder (CCD)-phenomenon… Anything else said or written is a lie" (USDA, 2015). Other, less defensible studies have purported to find that RF emissions from cell towers affect bees' behavior and could be responsible for colony collapse disorder. In general, these studies are not published in peer-reviewed and in credible journals.

An Appendix contains some well-known honeybee studies either published in predatory journals or that are informal in nature.

2.4.6. Conclusions on RF Emissions and Humans

Based on the analysis above, there is insufficient and inconclusive data to make a definitive determination of effect of RF emissions on humans. Although there is some evidence of adverse health effects at levels below the current standards in a number of studies, these studies are subject to a variety of uncertainties inherent in the epidemiological process. Conversely, the preponderance of the evidence to date does not definitively demonstrate that there are adverse health effects caused by RF emissions and there is still no single, plausible biological mechanism to indicate adverse effects.

2.4.7. Conclusions on RF Emissions and Animal/Plant Species

The amount of research related to determining whether there are identifiable effects from RF emissions to species is fairly extensive and growing, although inconclusive. Those referenced above are merely a few of the more recent studies that are directly applicable to RF emissions and communication towers and potentially pertinent to the evaluation of the proposed Project. The conclusions to be drawn by these studies vary, as the research is still too fragmented and inconclusive to demonstrate the needed cause and effect to various species caused by RF emissions. However, even in those studies that conducted quantitative analysis and research, the widespread conclusion is that more research is essential to better understand the patterns of cause and effect, variations among species, and the potential sensitivities and severity to such species.

The common practice for NEPA documents related to cellular towers is to cite FCC standards and point to the fact that they would be built and operated according to allowable FCC RF emission limits. Some NEPA documents that have more directly addressed the RF emissions potential largely point to the existing literature and suggest that although there is evidence that RF emissions could potentially affect some species, the evidence is insufficient to support a finding of adverse impacts on these species due to RF emissions (Ballistic Missile Defense Organization, 2000) (FCC, 2012).

2.4.8. Summary

FirstNet is a licensee of the FCC and FirstNet's operations in the 700 MHz range are governed by FCC regulations establishing exposure limits for RF emissions. Federal law authorizes the FCC to establish regulatory levels for human exposure to RF emissions. Over the years, the FCC has revised its standards and guidelines for protecting both workers and the general public—including limits for Maximum Permissible Exposure (MPE) for transmitters covering the 700MHz range and localized absorption limits for mobile devices—and these have been upheld by the federal courts.

Scientific investigations into RF emissions and the possible effects of exposure on humans, animals, and plants are inconclusive. These studies do not indicate any clearly reproducible trend and, consequently, there is insufficient and inconclusive data to make a definitive determination of effect of RF emissions on humans.

As discussed in detail above, while the science is currently inconclusive regarding the effects of RF emissions on humans and animals, FirstNet will continue to monitor any new studies or information that may come to light before the PEISs are finalized. Any new information or studies will be considered as part of the final analysis and incorporated, as appropriate, into the final document.

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3. COLORADO

American Indian tribes with a rich cultural history lived in what is now the state of Colorado for centuries before the 1800s (University of Northern Colorado, 2016). Colorado was acquired by the United States as part of the Louisiana Purchase in 1803, though it remained largely unexplored and uninhabited by European settlers until the 1850s. Colorado became a territory in 1861, and then became the 38th state in 1876 (Colorado State Archives, 1961). Colorado is bordered by Wyoming and Nebraska to the north, Utah to the west, Kansas and Nebraska to the east, and New Mexico and Oklahoma to the south. This chapter provides details about the existing environment of Colorado as it relates to the Proposed Action.

General facts about Colorado are provided below:

- **State Nickname**: The Centennial State
- **Area:** 103,642 square miles; **U.S. Rank**: 8 (U.S. Census Bureau, 2015z)
- **Capital:** Denver
- **Counties:** 64 (U.S. Census Bureau, 2015b)
- **2014 Estimated Population:** 5,355,866; **U.S. Rank:** 22 (U.S. Census Bureau, 2015z)
- **Most Populated Cites:** Denver, Colorado Springs, Aurora, and Fort Collins (U.S. Census Bureau, 2015b)
- **Main Rivers:** Arkansas River, Colorado River, and the South Platte River
- **Bordering Waterbodies:** None
- **Mountain Ranges:** Elk Mountains, Front Range, Mosquito Range, Park Range, Sangre de Cristo Mountains, San Juan Mountains, Sawatch Range, and Park Range
- **Highest Point:** Mt. Elbert (14,443 ft) (USGS, 2016a)

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3.1. AFFECTED ENVIRONMENT

3.1.1. Infrastructure

3.1.1.1. Definition of the Resource

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

Section 3.1.1.3 provides an overview of the traffic and transportation infrastructure in Colorado includes road and rail networks, and airport facilities. Colorado public safety infrastructure could include any infrastructure utilized by a public safety entity[1] as defined in Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Public Law [Pub. L.] No. 112-96, Title VI Stat. 156 (codified at 47 United States Code [U.S.C.] 1401 et seq.) ("the Act"), including infrastructure associated with police, fire, and emergency medical services (EMS). However, other organizations can qualify as public safety services as defined by the Act. Public safety services in Colorado are presented in more detail in Section 3.1.1.4. Section 3.1.1.5 describes public safety communications infrastructure and commercial telecommunications infrastructure in Colorado. An overview of utilities in Colorado, such as power, water, and sewer, are presented in Section 3.1.1.6.

3.1.1.2. Specific Regulatory Considerations

Table 3.1.1-1 identifies the relevant laws and regulations, the affected agencies, and their jurisdiction as derived from the state's applicable statutes and administrative rules referenced in column one. Appendix C, Environmental Laws and Regulations, identifies applicable federal laws and regulations.

Table 3.1.1-1: Relevant Colorado Infrastructure Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Code of Colorado Regulations: Chapter 1507 Department of Public Safety	Department of Public Safety; Division of Homeland Security and Emergency Management; Office of Emergency Management	Prepares, maintains, and keeps current a state disaster plan that complies with all applicable federal and state regulations; takes part in the development and revision of local and inter-jurisdictional disaster plans; establishes and manages a disaster emergency fund; establishes a uniform system for reporting and management of disaster and emergency management; builds

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

State Law/Regulation	Regulatory Agency	Applicability
		partnerships with first responders; enhances interagency cooperation through information sharing; operates states fusion center.
Colorado Revised Statues (CRS): Title 40 Utilities: Code of Colorado Regulations: Chapter 700 Department of Regulatory Agencies	Public Utilities Commission of Colorado	Includes every common carrier, pipeline corporation, gas corporation, electrical corporation, telephone corporation, water corporation, or person declared by law to be affected with a public interest; makes general or special orders, rules, or regulations or otherwise to require each public utility to maintain and operate its lines, plant, system, equipment, electrical wires, apparatus, tracks, and premises in such manner as to promote and safeguard the health and safety of its employees, passengers, customers, subscribers, and the public; considers cost-effective implementation of new clean energy and energy-efficient technologies.
CRS: Title 41 Aeronautics: Aircraft and Airports; Title 42 Vehicles and Traffic; Title 43 Transportation: Code of Colorado Regulations: Chapter 600 Department of Transportation	Department of Transportation; Transportation Commission and Office of Transportation Safety; Division of Highway Safety; Division of Transportation Development	Acquires and improves airports, air navigation facilities, and related facilities; plans, develops, constructs, coordinates, and promotes an integrated transportation system; initiates comprehensive planning measures and authorize such studies and other research necessary for the development of an integrated transportation system; maintains and administers the transportation infrastructure revolving fund; formulates the general policy with respect to the management, construction, and maintenance of public highways and other transportation systems.

3.1.1.3. Transportation

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

The Colorado Department of Transportation (CDOT) has jurisdiction over freeways and major roads, airports, and railroads, in the state; local counties have jurisdiction for smaller streets and roads. The mission of the CDOT is to "provide the best multi-modal transportation system for Colorado that most effectively and safely moves people, goods, and information" (CDOT, 2015a).

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

- 88,565 miles of public roads (FHWA, 2014a) and 8,668 bridges (FHWA, 2015a);
- More than 2,800 miles of track that includes passenger rail and freight (CDOT, 2012);

- 449 aviation facilities, including airstrips and heliports (FAA, 2015a); and
- No harbors or ports (U.S. Harbors, 2015).

Road Networks

As identified in Figure 3.1.1-1, the major urban centers of the state from north to south are Ft. Collins, Denver/Aurora, Colorado Springs, Pueblo, and in the west, Grand Junction. Colorado 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, state, and county roads. Table 3.1.1-2 lists the interstates and their start/end points in Colorado. 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 3.1.1-2: Colorado Interstates

Interstate	Southern or western terminus in CO	Northern or eastern terminus in CO
I-25	NM line near Starkville	WY line near Norfolk
I-70	UT line near Mack	KS line near Burlington
I-76	I-70 in Arvada	NE line near Julesburg

In addition to the Interstate System, Colorado has both National Scenic Byways and State Scenic Byways. National and State Scenic Byways are roads that are recognized for one or more archaeological, cultural, historic, natural, recreational, and scenic qualities (FHWA 2013). Figure 3.1.1-1 illustrates the major transportation networks, including roadways, in Colorado. Section 3.1.8, Visual Resources, describes the National and State Scenic Byways found in Colorado from an aesthetic perspective.

National Scenic Byways are roads with nationwide interest; the byways are designated and managed by the U.S. Department of Transportation's Federal Highway Administration. Colorado has 11 National Scenic Byways (FHWA, 2015c):

- Colorado River Headwaters Byway,
- Dinosaur Diamond Prehistoric Highway,
- Frontier Pathways Scenic and Historic Byway,
- Gold Belt Tour Scenic and Historic Byway,
- Grand Mesa Scenic and Historic Byway,
- Lariat Loop Scenic and Historic Byway,
- San Juan Skyway,
- Santa Fe Trail,
- Top of the Rockies,
- Trail of the Ancients, and
- Trail Ridge Road/Beaver Meadow Road.

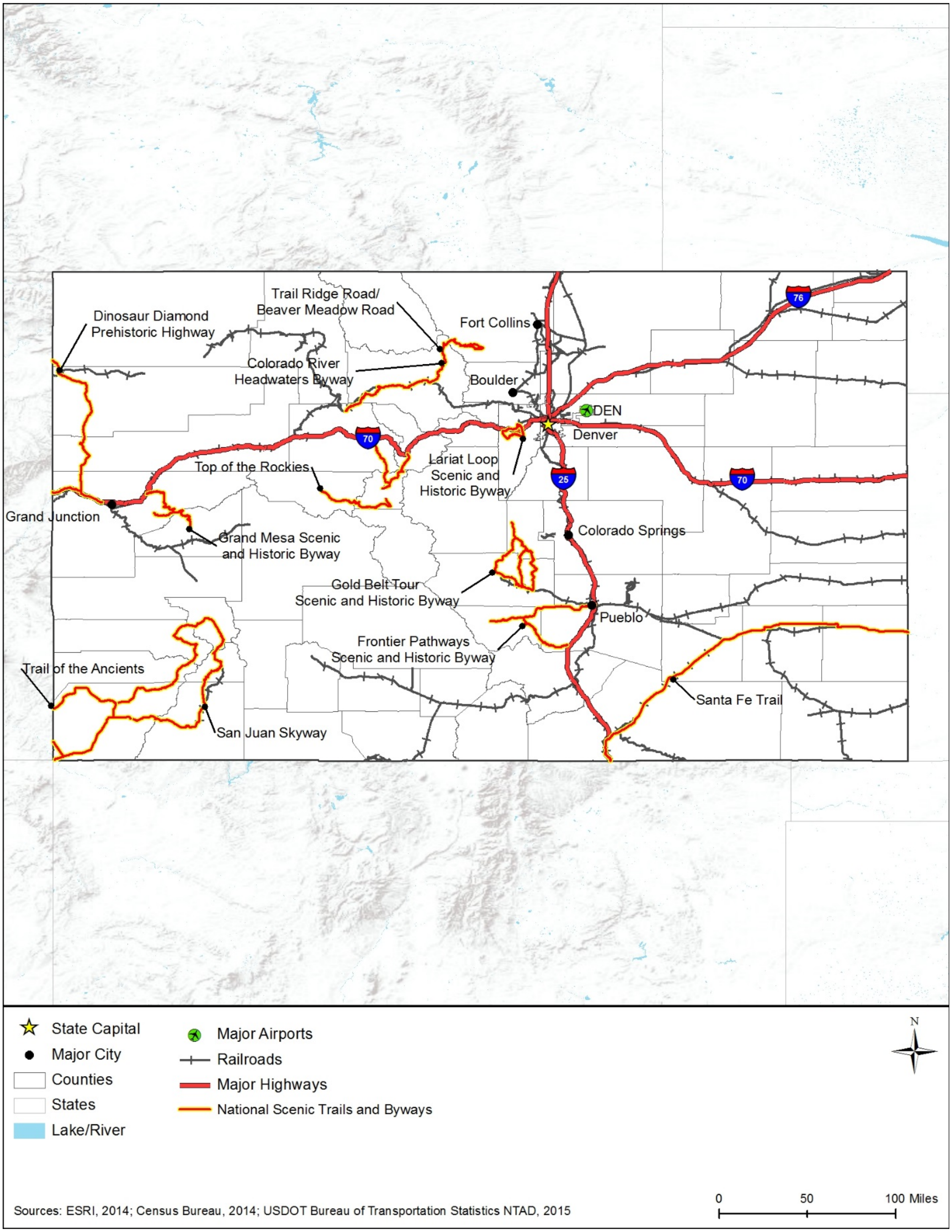

Figure 3.1.1-1: Colorado Transportation Networks

Colorado State Scenic Byways are roads with statewide interest; State Scenic Byways are designated and managed by CDOT. Some State Scenic Byways may be designated on portions of National Scenic Byways. Colorado has 15 State Scenic Byways in addition to the 11 National Scenic Byways (CDOT, 2015b) (Colorado Scenic and Historic Byways Program, 2016):

- Alpine Loop,
- Cache la Poudre-North Park,
- Collegiate Peaks,
- Flat Tops Trail,
- Guanella Pass,
- Highway of Legends,
- Los Caminos Antiguos,
- Mount Evans,
- Pawnee Pioneer Trails,
- Peak to Peak,
- Silver Thread,
- South Platte River Trail,
- Tracks Across Borders,
- Unaweep/Tabeguache, and
- West Elk Loop.

Airports

Air service to the state is provided primarily by Denver International Airport (DEN), a major international airport. This airport is the 15th busiest airport in the world and the 5th busiest in the United States (DEN, 2015a). DEN is owned by the City and County of Denver, and operated by Denver's Department of Aviation (DEN, 2015b). In 2014, the airport served 53,472,514 passengers, facilitated 575,161 aircraft operations, and handled 486,578,876 pounds of cargo (DEN, 2014). Figure 3.1.1-1 illustrates the major transportation networks, including airports, in the state. Section 3.1.7, Airspace, provides greater detail on airports and airspace in Colorado.

Rail Networks

Colorado is connected to a network of passenger rail (Amtrak), public transportation (commuter rail), and freight rail. Figure 3.1.1-1 illustrates the major transportation networks, including rail lines, in Colorado.

Amtrak runs two lines through Colorado. The California Zephyr runs daily between Chicago and San Francisco Bay area, cutting across northern Colorado, and making six stops in the state. Covering 2,438 miles, it is Amtrak's longest route (CDOT, 2012). The Southwest Chief runs daily across the American West, from Chicago to Los Angeles, stopping at three stations in southeastern Colorado along the way. In 2011, Amtrak served approximately 206,000 riders in Colorado on the Zephyr and Chief lines (CDOT, 2012). Table 3.1.1-3 provides a complete list of Amtrak lines that run through Colorado.

The Regional Transportation District (RTD) provides light rail service in the Denver metro area. RTD currently operates six light rail lines over 48 miles of rail service (RTD 2016). The system serves 46 stations in the southern and western sections of Denver (RTD, 2015). RTD will add four new commuter rail lines in 2016 (CDOT 2012). The RTD system currently has of 48 miles of track and 172 vehicles (RTD 2016).

Table 3.1.1-3: Amtrak Train Routes Serving Colorado

Route	Starting Point	Ending Point	Length of Trip	Cities Served in Colorado
California Zephyr	Chicago, IL	Emeryville, CA	51 hours 20 minutes	Fort Morgan, Denver, Fraser, Granby, Glenwood Springs, Grand Junction
Southwest Chief	Chicago, IL	Los Angeles, CA	40+ hours	Lamar, La Junta, Trinidad

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

Freight railroads own and operate all 2,684 miles of active railroad track in Colorado (CDOT, 2012). The freight rail network reaches 48 out of 64 counties in the state (CDOT, 2012). The Federal Railroad Administration (FRA) classifies railroads as Class I, Class II, or Class III based on corporate revenue thresholds (FRA, 2015a). Fourteen freight rail companies operate in Colorado: BNSF and Union Pacific are the two Class I railroads in Colorado; there are also 10 short line railroads and 2 switching/terminal railroads in the state (CDOT, 2012). About 33 percent of all freight in Colorado travels via railroad (CDOT, 2012). In 2009, Colorado's freight rail system handled almost 164 million kgs, most of which was coal (CDOT, 2012).

Harbors and Ports

The state of Colorado is landlocked and has no harbors or ports (World Port Source, 2016).

3.1.1.4. Public Safety Services

Colorado public safety services generally consist of public safety infrastructure and first responder personnel aligned with the demographics of the state. The general abundance and distribution of public safety services may roughly follow key state demographic indicators. Table 3.1.1-4 presents Colorado's key demographics including estimated population; land area; population density; and number of municipal governments. More information about these demographics is presented in Section 3.1.9, Socioeconomics.

Table 3.1.1-4: Key Colorado Indicators

Colorado Indicators	
Estimated Population (2014)	5,355,866
Land Area (square miles) (2010)	103,641.89
Population Density (persons per sq. mile) (2010)	48.5
Municipal Governments (2013)	271

Sources: (U.S. Census Bureau, 2015c) (U.S. Census Bureau, 2013) (National League of Cities 2007)

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

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

Infrastructure Type	Number
Fire and Rescue Stations [a]	859
Law Enforcement Agencies [b]	246
Fire Departments [c]	325

[a] Data collected by the U.S. Fire Administration in 2015.

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

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

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

Table 3.1.1-6: First Responder Personnel in Colorado by Type

First Responder Personnel	Number
Police, Fire and Ambulance Dispatchers [a]	1,660
Fire and Rescue Personnel [b]	13,202
Law Enforcement Personnel [c]	17,989
Emergency Medical Technicians and Paramedics [d, e]	4,110

[a] BLS Occupation Code: 43-5031.

[b] BLS Occupation Codes: 33-2011 (Firefighters), 33-2021 (Fire Inspectors and Investigators), 33-1021 (First-Line Supervisors of Fire Fighting and Prevention Workers), and 53-3011 (Ambulance Drivers and Attendants, Except Emergency Medical Technicians). Volunteer firefighters reported by the U.S. Fire Administration.

[c] Full-time employees from state and local law enforcement agencies which include: local police departments, sheriffs' offices, primary state law enforcement agencies, special jurisdictional agencies, and other miscellaneous agencies, collected by the U.S. Bureau of Justice Statistics in 2008.

[d] BLS Occupation Code: 29-2041.

[e] All BLS data collected in 2015.

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

3.1.1.5. Telecommunications Resources

There is no central repository of information for public safety communications infrastructure and commercial telecommunications infrastructure in Colorado; therefore, the following information and data are combined from a variety of sources, as referenced. Communications throughout the state are based on a variety of publicly- and commercially-owned technologies.

Figure 3.1.1-2 presents a typical wireless configuration including both a narrowband public safety land mobile radio network (traditional radio network) and a commercial broadband access network (wireless technology); backhaul (long-distance wired or wireless connections), core, and commercial networks including a long term evolution (LTE) evolved packet core (modern broadband cellular networks); and network applications (software) delivering voice, data, and video communications (FCC, 2016a).

Public Safety Communications

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

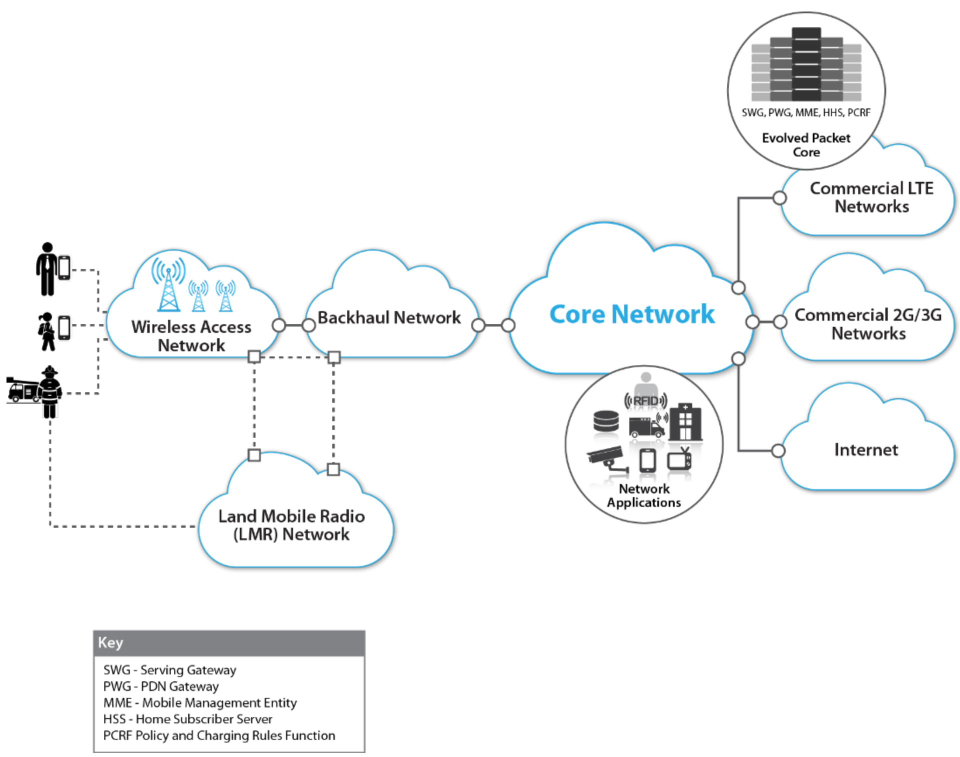

Figure 3.1.1-2: Wireless Network Configuration

Prepared by: Booz Allen Hamilton

There are five key reasons why public safety agencies often cannot connect through existing communications (NTFI, 2005):

- Incompatible and aging communications equipment,
- Limited and fragmented funding,
- Limited and fragmented planning,
- A lack of coordination and cooperation, and
- Limited and fragmented radio spectrum.

To help enable the public safety community to incorporate disparate Land Mobile Radio networks with a nationwide public safety LTE broadband network, the U.S. Department of Commerce Public Safety Communications Research (PSCR), prepared a locations-based services (LBS) research and development "roadmap" to examine the current state of location-based technologies. The program also forecasts the evolution of LBS capabilities and gaps, and identify potential research and development opportunities that would improve the public safety community's use of LBS within operational settings. This is the first of several technology roadmaps that PSCR plans to develop over the next few years (PSCR, 2015).

Public safety network communications in Colorado reflect a combination of legacy analog Very High Frequency (VHF),[2] Ultra High Frequency (UHF)[3] radios operating across multiple frequencies bands as well as a statewide digital Project 25 (P-25) 700 MHz/800 MHz network called Digital Trunk Radio System (DTRS) (RadioReference.com, 2015a). The Office of Information Technology (OIT)'s summaries the DTRS infrastructure, coverage, and usage as follows, "The infrastructure currently consists of 220 active radio sites operating on five Zone Controllers and provides mobile radio coverage to approximately 95 percent of the state highways. The system utilizes frequencies in both the 700 MHz and 800 MHz bands. There are over 1,000 state, local, county, and federal and tribal agencies and over 82,000 subscriber radios using DTRS. Approximately one-third of the users are state agencies and two-thirds of the users are local and federal agencies. The system averaged more than 9,000 hours of talk time each month and handled over 103 million calls in 2014" (Colorado OIT, 2015).

The responsibility for the operations and management of Colorado's P25 700 MHz/800 MHz DTRS network is with the Governor's OIT (Colorado OIT, 2015). OIT has received recurring input on system needs and governance input for over a decade from an active user consortium, known as the Consolidated Communications Network of Colorado (CCNC): "In August 2002, the CCNC, a formalized DTRS user group, was formed. CCNC participants include all full and associate members using the DTRS, and CCNC governs participation on the system. All levels of government from municipal to federal, as well as all types of first responders ranging from police, fire, EMS, public works, schools, hospitals, utilities and transit are represented in the CCNC membership." (Colorado OIT, 2015). In 2014, however, due to a legislative change, CCNC was rescinded and replaced by the Public Safety Communications Subcommittee (PSCS) which was created in June 2014 (PSCS, 2014). The PSCS is charged with a broader mission to

[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)

focus on a more inclusive consideration of networks beyond CCNC's focus on the DTNR network and to include the broader array of current regional and other localized networks in future interoperability and Public Safety network planning (PSCS, 2014).

In 2010, the Adams County Communications Center, Inc. (ADCOM) was awarded a National Telecommunications Information Administration (NTIA) Broadband Technologies Opportunity Program (BTOP) infrastructure grant. The purpose was to build a 700 MHz broadband network to enhance public safety communications and broadband connectivity to municipal agencies and school districts in Adams County and surrounding areas including the Denver International Airport (DEN) (NTIA, 2015). The network currently serves 15 Public Safety Community Anchor Institutions (CAIs) (NTIA, 2015). Also in 2010, a Colorado statewide BTOP infrastructure fiber and wireless grant was awarded to Centennial Board of Cooperative Educational Services (CBOCES) now doing business as Eagle-Net Alliance. The Eagle-Net Alliance is a middle-mile network and its network passes or connects to 308 Public Safety CAIs in Colorado by facilitating last-mile connections to these Public Safety locations across Colorado (EagleNet-Alliance, 2015).

Statewide Public Safety Networks

The DTRS is a digital Phase 1[4] P-25[5] network which provides statewide coverage in Colorado, addresses interoperability, enables mutual aid, and interfaces with neighboring Wyoming's statewide P-25 network, WyoLink (RadioReference.com, 2015a). Operating with 220 active radio sites in 2014, DTRS' plan is to continue to expand the footprint of its network into 2015-16 (Colorado OIT, 2015).

Figure 3.1.1-3 below provides a depiction of the breadth of the DTRS network's coverage in the state (RadioReference.com 2015a).

[4] Phase 1 P25 networks use the digital Frequency Division Multiple Access (FDMA) channel management regime.
[5] Project-25 (P25) is a suite of standards for digital radio communications for use by federal, state, and local public safety agencies in North America to enable them to communicate with other agencies and mutual aid response teams in emergencies.

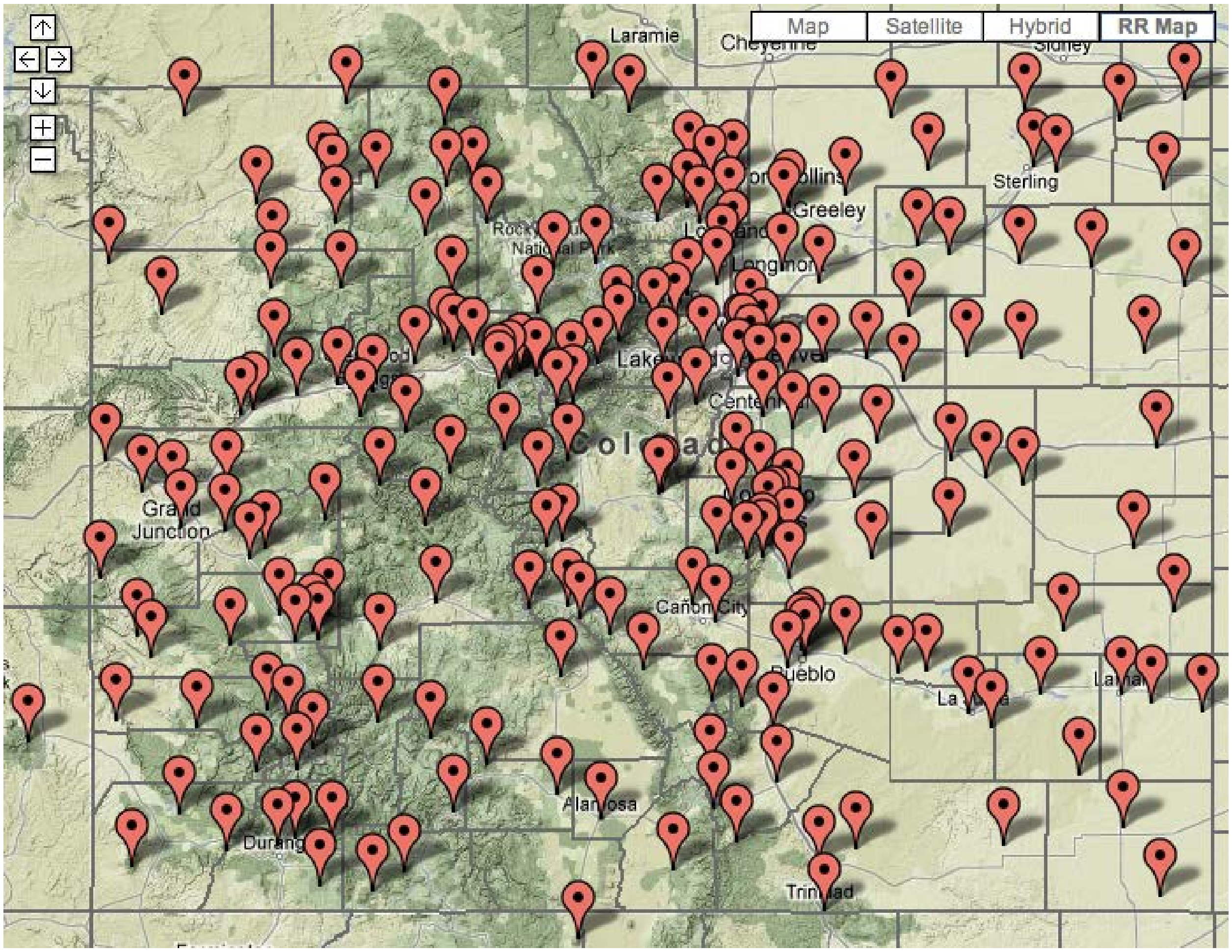

Figure 3.1.1-3: Colorado's DTRS Network Radio Site Locations

(RadioReference.com, 2015a)

The DTRS network also enables statewide mutual aid on a single Mutual Aid Channel (MAC), known as MAC-21; additionally, DTRS supports 5 Mutual Aid Channels on a regional level in Colorado as Figure 3.1.1-4 depicts (RadioReference.com 2015a)

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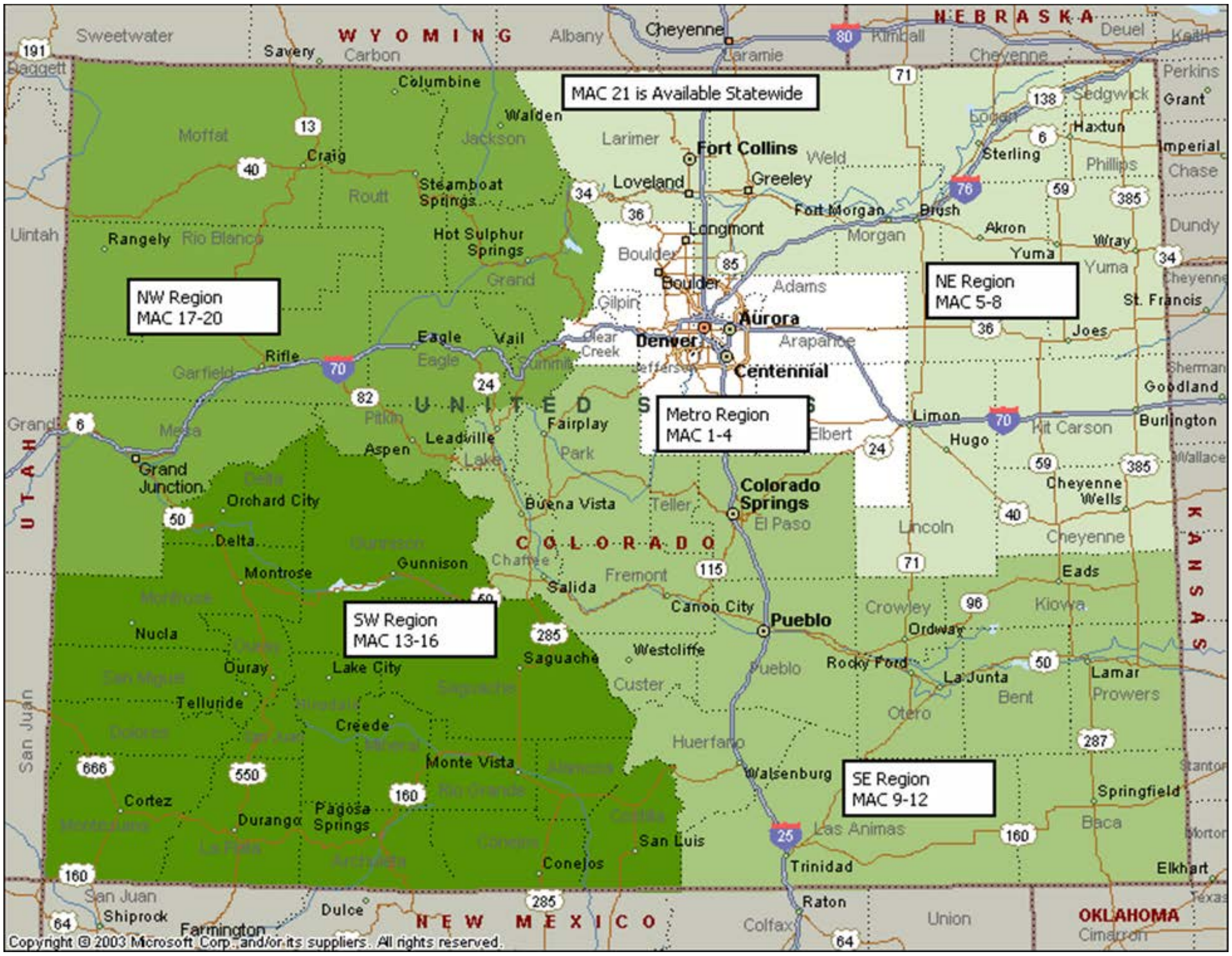

Figure 3.1.1-4: Colorado Mutual Aid Statewide and Regional Channels

(RadioReference.com, 2015a)

As a statewide network with 95 percent coverage of the state, DTRS enjoys broad adoption across a diverse set of public safety and emergency communications users from state police, fire, and EMS through county and local police, fire, and emergency medical service users.

The Colorado State Patrol (state police) for example, use the DTRS 700 MHz/800 MHz network for all of its primary operations with ancillary use of VHF frequencies for tactical communications and dispatch (RadioReference.com, 2015b). Colorado's Site on Wheels (SOW) infrastructure is supported by the DTRS Phase 1 P-25 network, as are a large number of Colorado state agencies including: Colorado Department of Transportation (CDOT), Colorado Statewide Mountain Search & Rescue, and Colorado State Forest Service (RadioReference.com, 2015c).

City and County Public Safety Networks

The statewide DTRS network is the primary public safety system across Colorado's counties as Figure 3.1.1-5 indicates; however, 13 counties (of a total of 64, as of 2014, and shaded in the graphic below) continued to use legacy VHF networks for the primary communications needs of their county (DenverRadio.com, 2015).

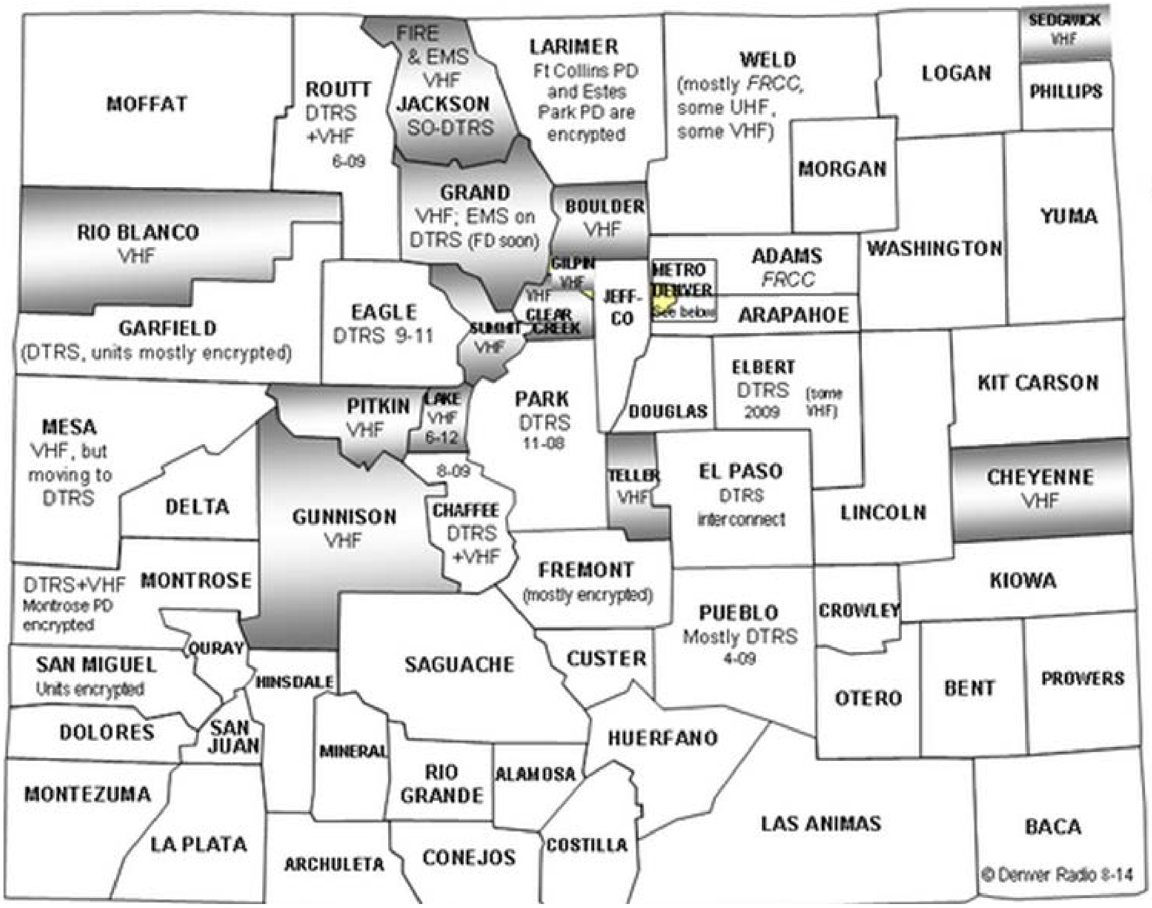

Figure 3.1.1-5: County-level Adoption of the DTRS Digital P-25 Network in Colorado

(DenverRadio.com, 2015)

In addition to the 700 MHz/800 MHz statewide digital Phase 1 DTRS network in Colorado there are currently three Phase 2[6] multi-county/county P-25 networks operating in the state: (1) Front Range Communications Consortium (700 MHz[7]), (2) Metro Area Radio Cooperative (MARC) (800 MHz)[8], and (3) Westminster P25 Public Safety Network (800 MHz)[9] (Project 25 Org, 2015).

[6] Phase 2 P-25 networks use the Time Division Multiple Access (TDMA) digital channel management regime.
[7] FRCC's Phase 2 P-25 network was formed to serve three counties: Adams, Weld, and Broomfield.
[8] The MARC Phase 2 P-25 system is in use in Jefferson County (just southwest of Denver) and by the cities of Arvada, Lakewood, and Wheatridge operate on this network.
[9] Westminster is northwest suburb of Denver in Adams and Jefferson counties; its Phase 2 P-25 network is a two site, 10 channel system.

Public Safety Answering Points (PSAP)

According to the FCC's Master PSAP registry, there are 201 PSAPs in Colorado serving Colorado's 64 counties (FCC, 2016b).

Commercial Telecommunications Infrastructure

Colorado'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 subsections present information on Colorado'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

Colorado'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 for connectivity. Table 3.1.1-7 presents the number of providers of switched access[10] lines, Internet access,[11] and mobile wireless services including coverage.

Table 3.1.1-7: Telecommunications Access Providers and Coverage in Colorado as of December 31, 2013

Commercial Telecommunications Access Providers	Number of Service Providers	Coverage of Households
Switched access lines[a]	189	97% of households
Internet access[b]	93	69% of households
Mobile wireless[c]	63	95% of population

[a] Switched access lines are a service connection between an end user and the local telephone company's switch (the basis of older telephone services); this number of service providers was reported by the FCC as of December 31, 2013 in Table 17 in "Local Telephone Competition: Status as of December 31, 2013" as the total of ILEC and non-ILEC providers (FCC, 2014b).

[b] Internet access providers are presented in Table 21 in "Internet Access Services: Status as of December 31, 2013" by technology provided; number of service providers is calculated by subtracting the reported Mobile Wireless number from the total reported number of providers (FCC, 2014a).

[c] Mobile wireless provider data is provided by the FCC in the sources identified. However, NTIA's National Broadband Map provides newer data, so FirstNet is using NTIA's GIS-based data from the National Broadband Map instead of the data reported by the FCC. The process for retrieving the National Broadband Map data is explained in detail in a subsequent footnote in Section 3.1.1.5, Last Mile Fiber Assets.

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

[10] "A service connection between an end user and the local telephone company's switch; the basis of plain old telephone services." (FCC, 2014b)

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

Table 3.1.1-8 shows the wireless providers in Colorado along with their geographic coverage. The following five maps, Figure 3.1.1-6 through Figure 3.1.1-10, show the combined coverage for the top two providers AT&T and Verizon; Sprint and T-Mobile's coverage; Viaero and Skybeam coverage; Commnet, Kentec, and Rebeltec's coverage; and the coverage of all other wireless providers with less than 5 percent coverage area, respectively.[12]

Table 3.1.1-8: Wireless Telecommunications Coverage by Providers in Colorado

Wireless Telecommunications Providers	Coverage
AT&T Corp, Inc.	76.63%
Verizon Wireless	69.91%
Viaero Wireless	35.18%
Sprint	19.53%
T-Mobile	12.91%
Skybeam, Inc.	11.47%
Commnet Wireless	10.50%
Rebeltec Communications, LLC	7.85%
Kentec Communications Inc.	6.35%
Other[a]	35.32%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5% coverage area. Providers include: Zero Error Networks, LLC; Cricket Communications, Inc.; SECOM; Jade Communications, LLC; Wifi West; Ark Valley Internet; DirectLink, LLC; MHO Networks; Premier Systems Unlimited Inc.; Zirkel Wireless; Brainstorm Internet; Diverse Datum, Inc.; ghValley.net; Roggen Telephone Enterprises, Inc.; PCTelecom; Plains Cooperative Telephone Association, Inc.; HiSpeed 4 U, Inc.; Grand Valley Telecommunications, Inc.; Vision Wireless Communications; Grand County Internet Services; Peetz Cooperative Telephone Company; Fundamental Holdings, Corp.; Vistabeam; Elite Broadband; Bijou Telephone Cooperative Association, Inc.; Aerux Broadband; Windspeed Networks, LLC; SkyWerx Industries, LLC; Nucla-Naturita Telephone Company; Colorado Wireless Exchange Cooperative; Slopeside Internet, LLC; Internet Colorado; BySky, Inc.; Eagle Cable TV And Internet; Chase 3000, Inc.; Mountain Broadband Network and Communications; Nedernet, Inc.; Mountain Computer WIzards, Inc.; Farmers Telecommunications; Pine Drive Telephone Company; FairPoint Communications; PCI Broadband; San Isabel Telecom, Inc.; MRIC; Estes Valley Networks, Inc.; K2 Communications, LLC; Kremmling Technology Services; OurayNet; Airbits, LLC; LiveWire Networks, Inc.; Cityless Internet Services, LLC; DTE; City of Glenwood Springs, Community Broadband Network; USA Communications.

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

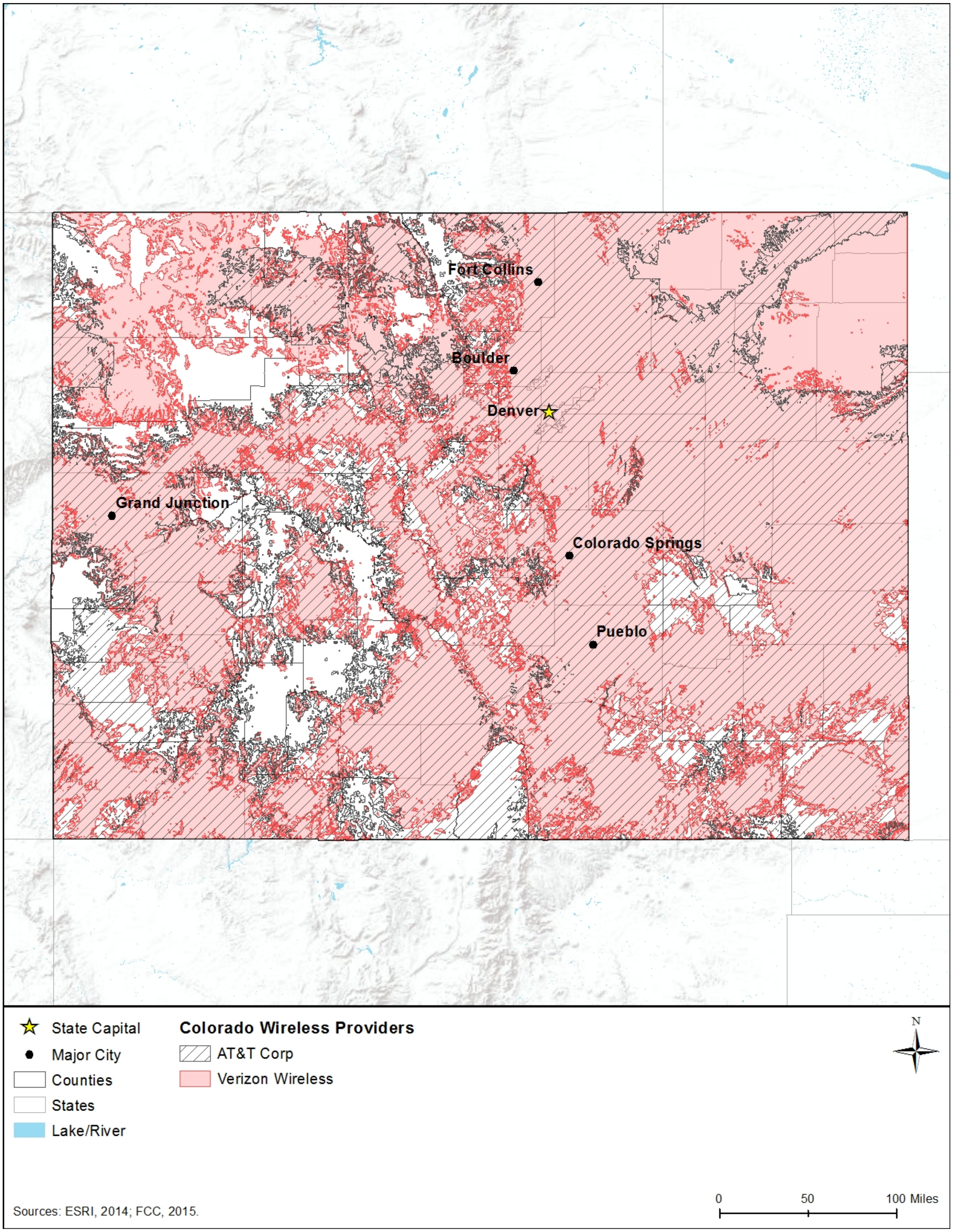

Figure 3.1.1-6: AT&T Corp. and Verizon Wireless Availability in Colorado

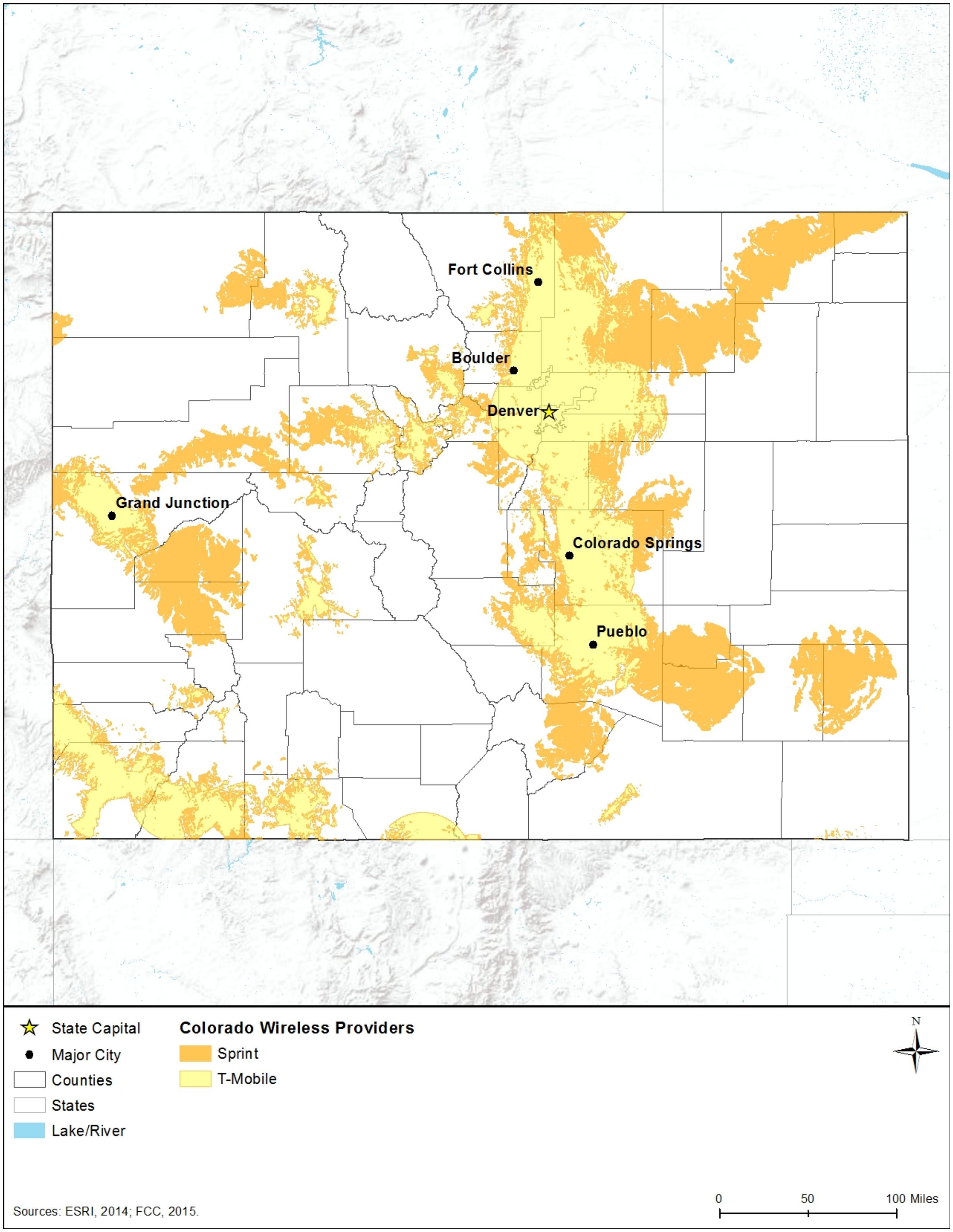

Figure 3.1.1-7: Sprint and T-Mobile Wireless Availability in Colorado

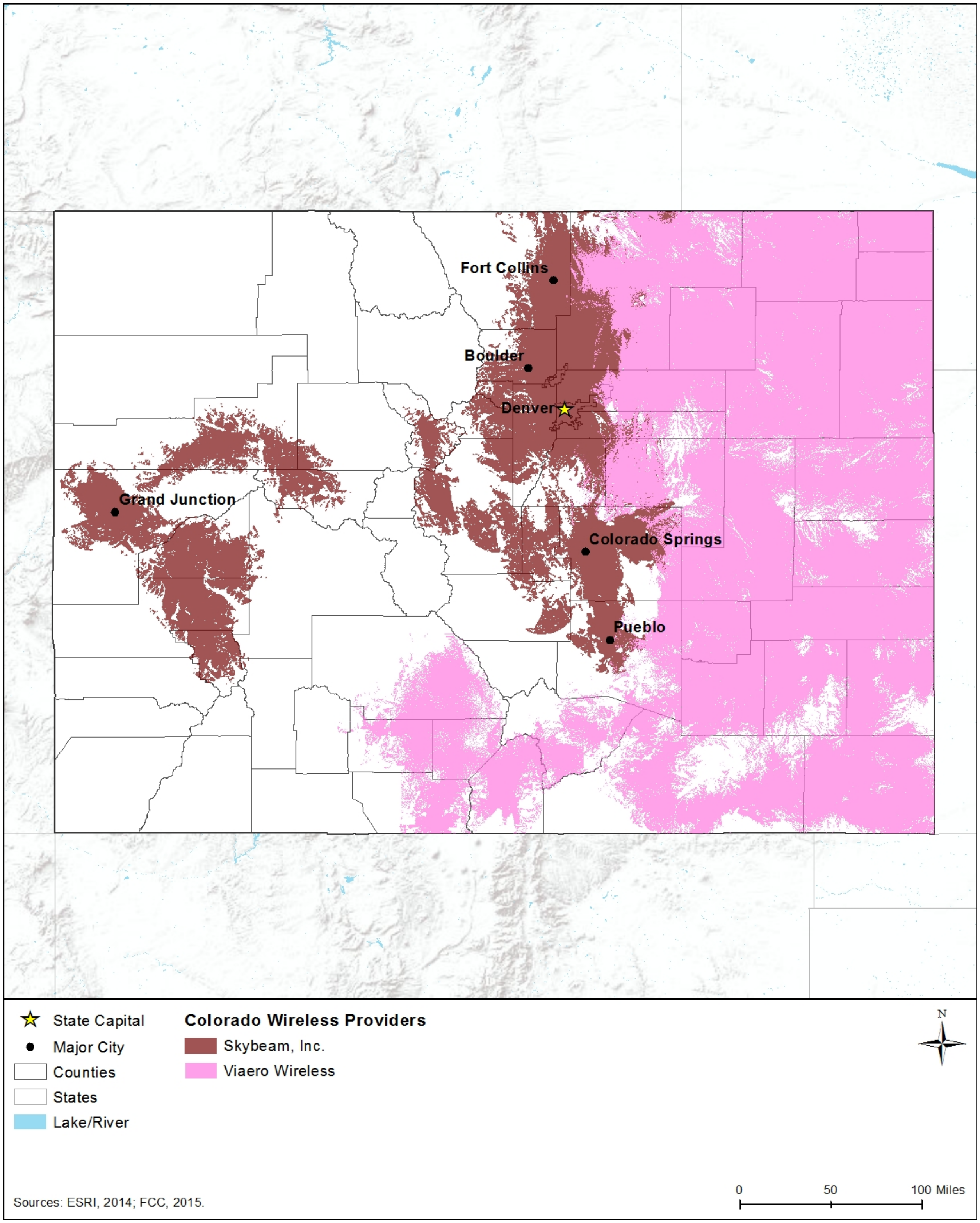

Figure 3.1.1-8: Viaero Wireless and Skybeam, Inc. Availability in Colorado

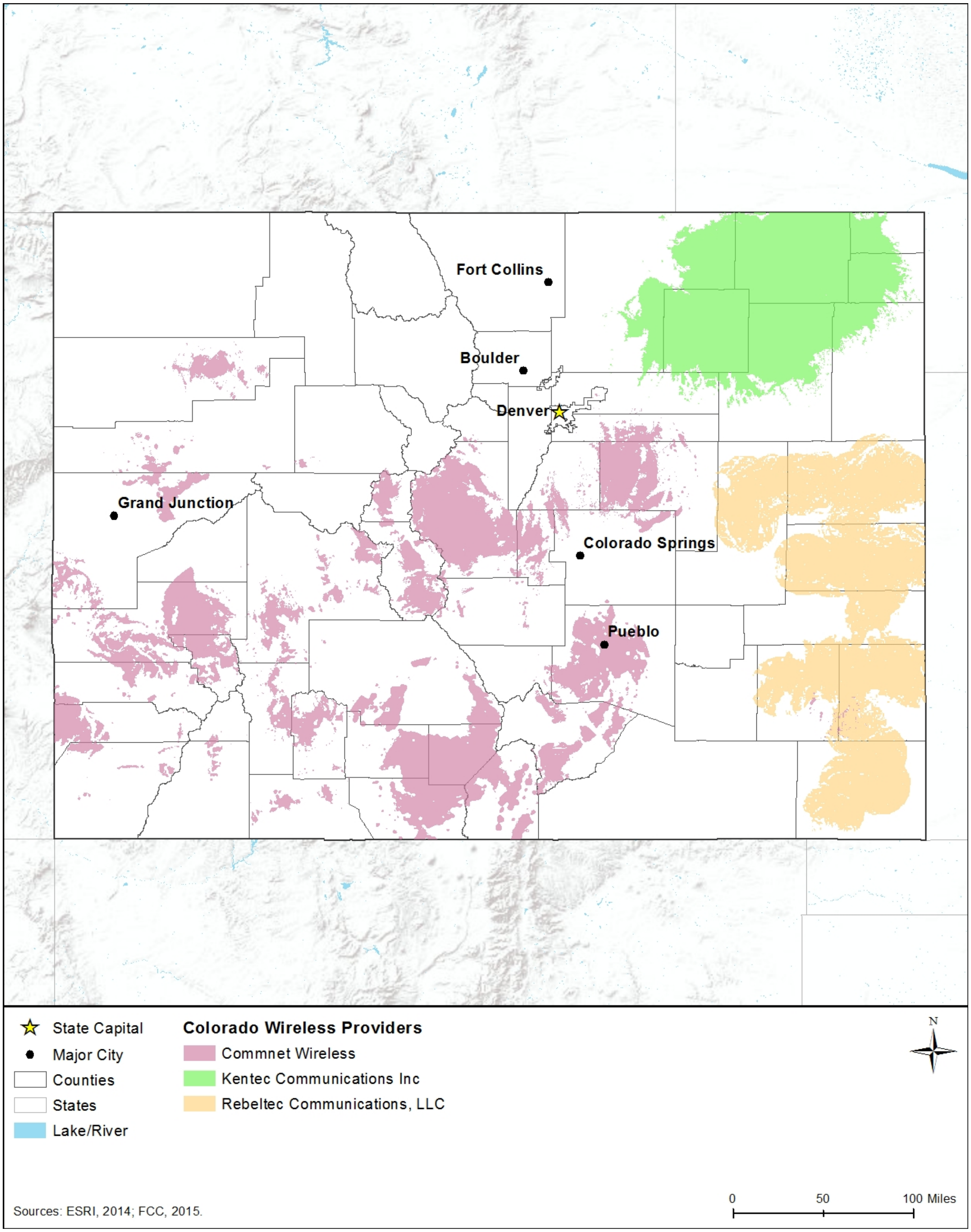

Figure 3.1.1-9: Commnet Wireless, Kentec Communications, Inc., and Rebeltec Communications, LLC Wireless Availability in Colorado

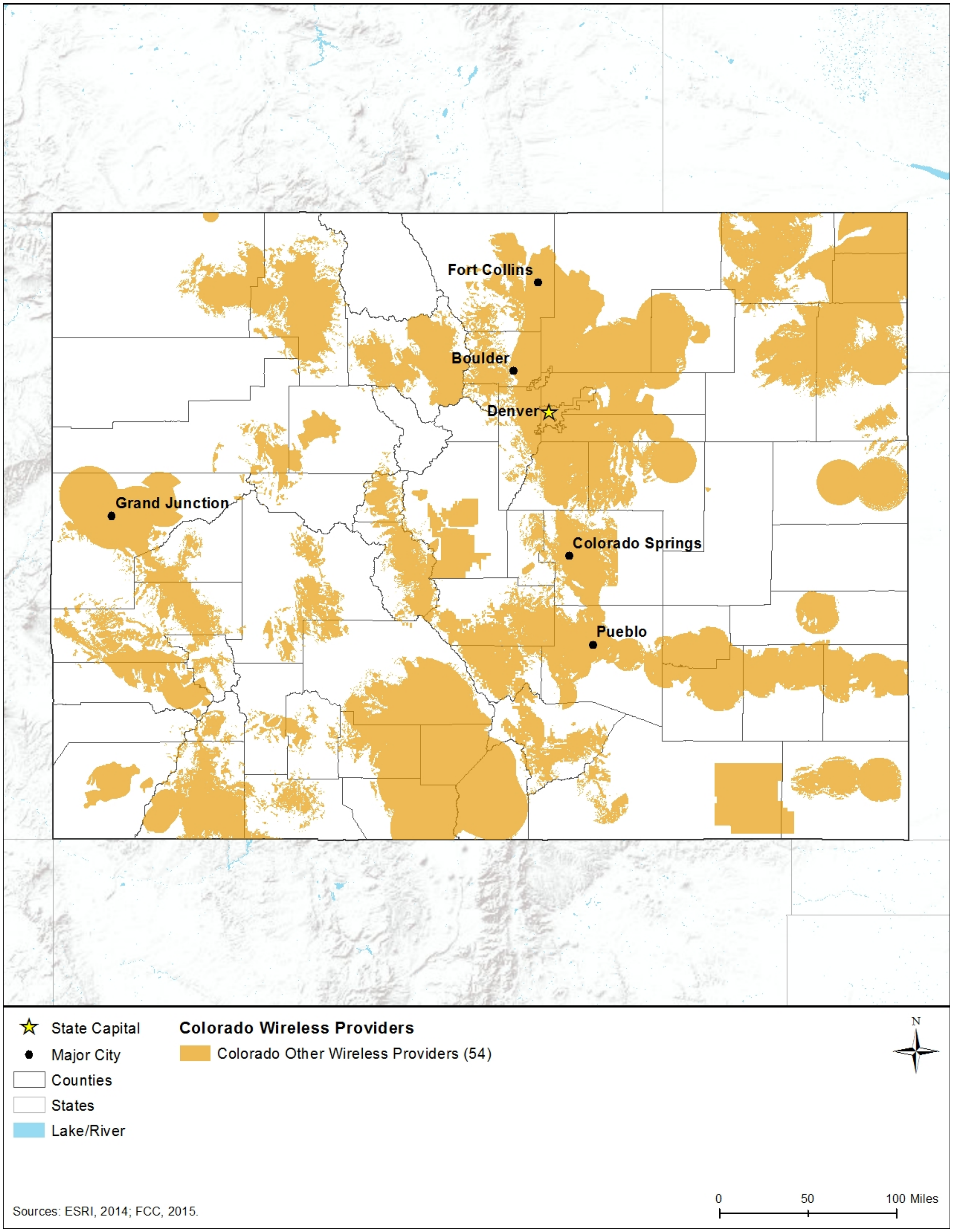

Figure 3.1.1-10: Other Providers Wireless Availability in Colorado

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 3.1.1-11 presents representative examples of each of these categories or types of towers.

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

Lattice
200 – 400 feet
Source: Personal Picture

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

Figure 3.1.1-11: Types of Towers

Telecommunications tower infrastructure proliferates throughout Colorado, although tower infrastructure is concentrated in the more densely populated areas of Denver, Colorado Springs, Boulder, Fort Collins, Pueblo, and Grand Junction (FCC, 2015). Owners of towers and some types of antennas are required to register those infrastructure assets with the FCC (FCC, 2016b).[13] Table 3.1.1-9 presents the number of towers (including broadcast towers) registered with the FCC in Colorado, by tower type, and Figure 3.1.1-12 presents the location of those structures, as of June 2016.

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

Table 3.1.1-9: Number of Commercial Towers in Colorado by Type

Constructed[a] Towers[b]		Constructed Monopole Towers	
100ft and over	134	100ft and over	0
75ft – 100ft	121	75ft – 100ft	0
50ft – 75ft	151	50ft – 75ft	3
25ft – 50ft	191	25ft – 50ft	15
25ft and below	190	25ft and below	41
Subtotal	**787**	**Subtotal**	**59**
Constructed Guyed Towers		**Buildings with Constructed Towers**	
100ft and over	12	100ft and over	0
75ft – 100ft	17	75ft – 100ft	2
50ft – 75ft	17	50ft – 75ft	3
25ft – 50ft	4	25ft – 50ft	8
25ft and below	4	25ft and below	4
Subtotal	**54**	**Subtotal**	**17**
Constructed Lattice Towers		**Multiple Constructed Structures[c]**	
100ft and over	4	100ft and over	0
75ft – 100ft	14	75ft – 100ft	1
50ft – 75ft	25	50ft – 75ft	0
25ft – 50ft	20	25ft – 50ft	0
25ft and below	25	25ft and below	0
Subtotal	**88**	**Subtotal**	**1**
Constructed Tanks[d]			
Tanks	2		
Subtotal	**2**		
Total All Tower Structures		**1,008**	

Source: (FCC, 2015)

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

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

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

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

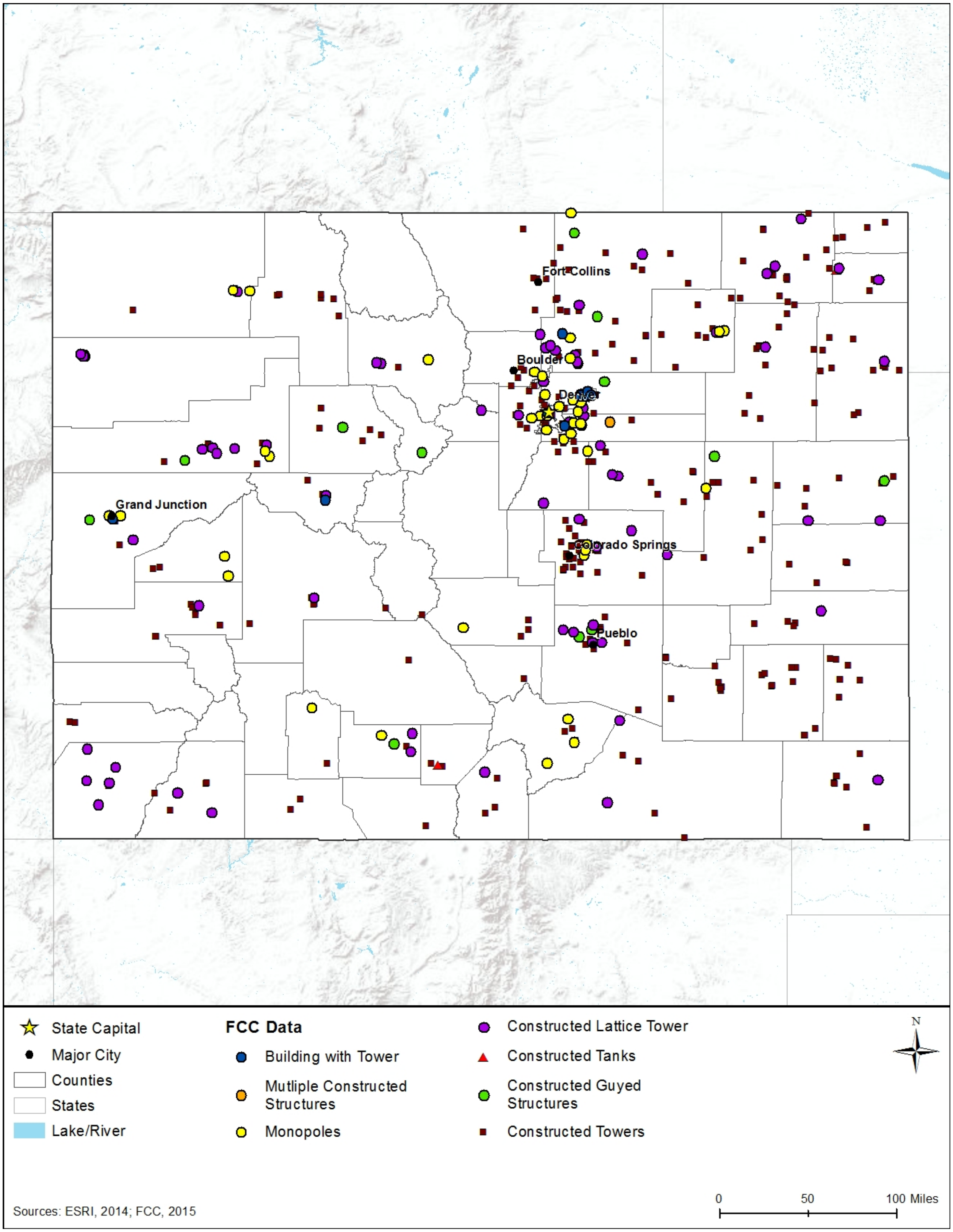

Figure 3.1.1-12: FCC Tower Structure Locations in Colorado

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 3.1.1-13 (FCC, 2000). The network also may include a middle mile component (shorter distance cables linking the core network between central offices or network nodes across a region) and a long haul network component (longer distance cables linking central offices across regions). (FCC, 2000)

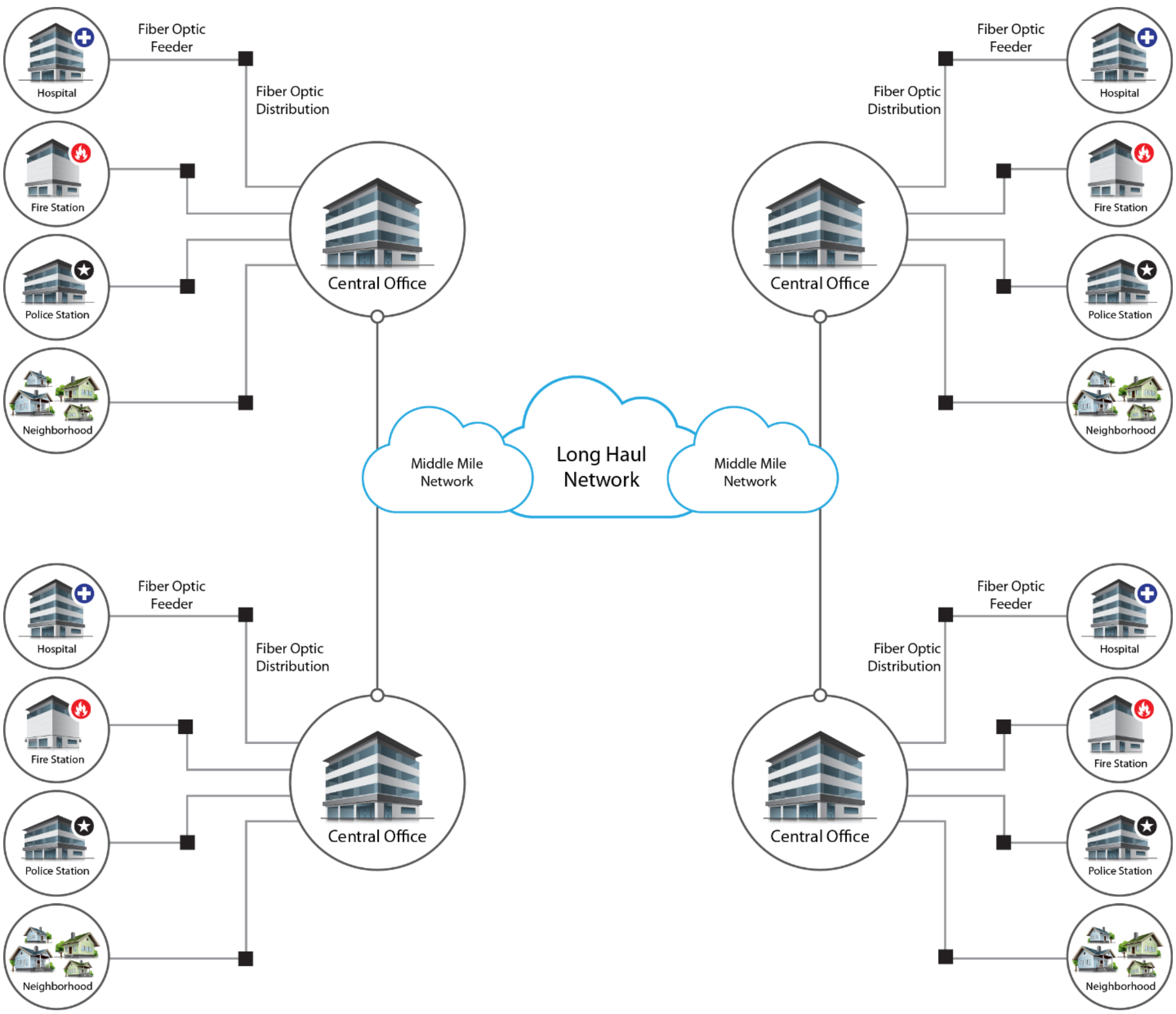

Figure 3.1.1-13: Typical Fiber Optic Network in Colorado

Prepared by: Booz Allen Hamilton

Source: (ITU-T 2012)

Last Mile Fiber Assets

In Colorado, fiber access networks are concentrated in the highest population centers as shown in the figures below. In Colorado there are 56 fiber providers that offer service in the state, as listed in Table 3.1.1-10. Figure 3.1.1-14 shows coverage for CenturyLink and Integra Telecom; Figure 3.1.1-15 shows coverage for Megpath Corporation, Comcast, and Eastern Slope Rural Telephone Association, Inc.; and Figure 3.1.1-16 shows the coverage area for all other fiber providers with less than 5 percent coverage area.

Table 3.1.1-10: Fiber Provider Coverage in Colorado

Fiber Provider	Coverage
CenturyLink	5.91%
Integra Telecom	3.46%
MegaPath Corporation	2.42%
Comcast	1.72%
Eastern Slope Rural Telephone Association, Inc.	1.05%
Other[a]	5.54%

Source: (NTIA, 2014)

[a] Other: Provider with less than 5% coverage area. Providers include: Plains Cooperative Telephone Association, Inc.; Bresnan Communications; Haxtun; Wiggins Telephone; TDS Telecom; PCTelecom; Blanca Telephone Company; ghValley.net; Kentec Communications Inc.; Front Range Internet, Inc.; FairPoint Communications; Bijou Telephone Cooperative Association, Inc.; Nunn Communication, LLC; Big Sandy Telecom, Inc.; Farmers Telephone Company; San Isabel Telecom, Inc.; Microtech-tel; Peetz Cooperative Telephone Company; Pine Drive Telephone Company; Level 3 Communications, LLC; K2 Communications, LLC; Tw Telecom Of Colorado LLC; Strata Networks; Nucla-Naturita Telephone Company; Time Warner Cable; Prairie Networks, LLC; TW Telecom of Colorado, LLC; Spring Creek Cable; Falcon Broadband, Inc.; Grand Valley; Telecommunications, Inc.; DTE; FastTrack Communications, Inc.; Brainstorm Internet; Vyve Broadband; S&T Telephone Coop Association Inc.; USA Communications; Internet Colorado; Unite Private Networks; Zayo Enterprise Networks, LLC; SECOM Rico Telephone Company; Fundamental Holdings, Corp.; Great Plains Communications, Inc.; Eagle Cable TV And Internet; Lyons Communications, LLC; City of Glenwood Springs, Community Broadband Network; Mountain Village Owners Association; LiveWire Networks, Inc.; Cardinal Broadband, LLC; Rebeltec Communications, LLC; Cogent Communications, Inc.

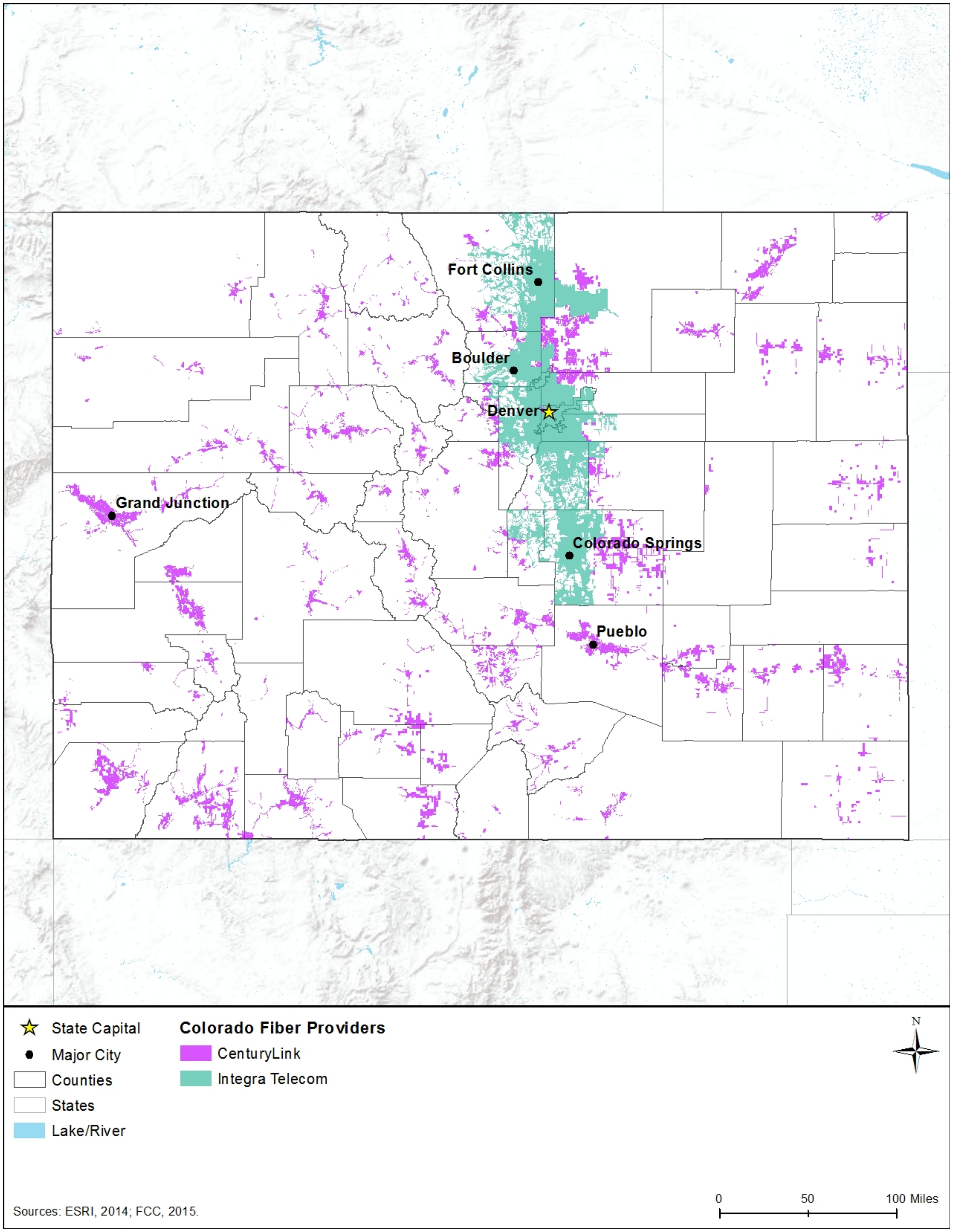

Figure 3.1.1-14: CenturyLink and Integra Telecom Fiber Availability in Colorado

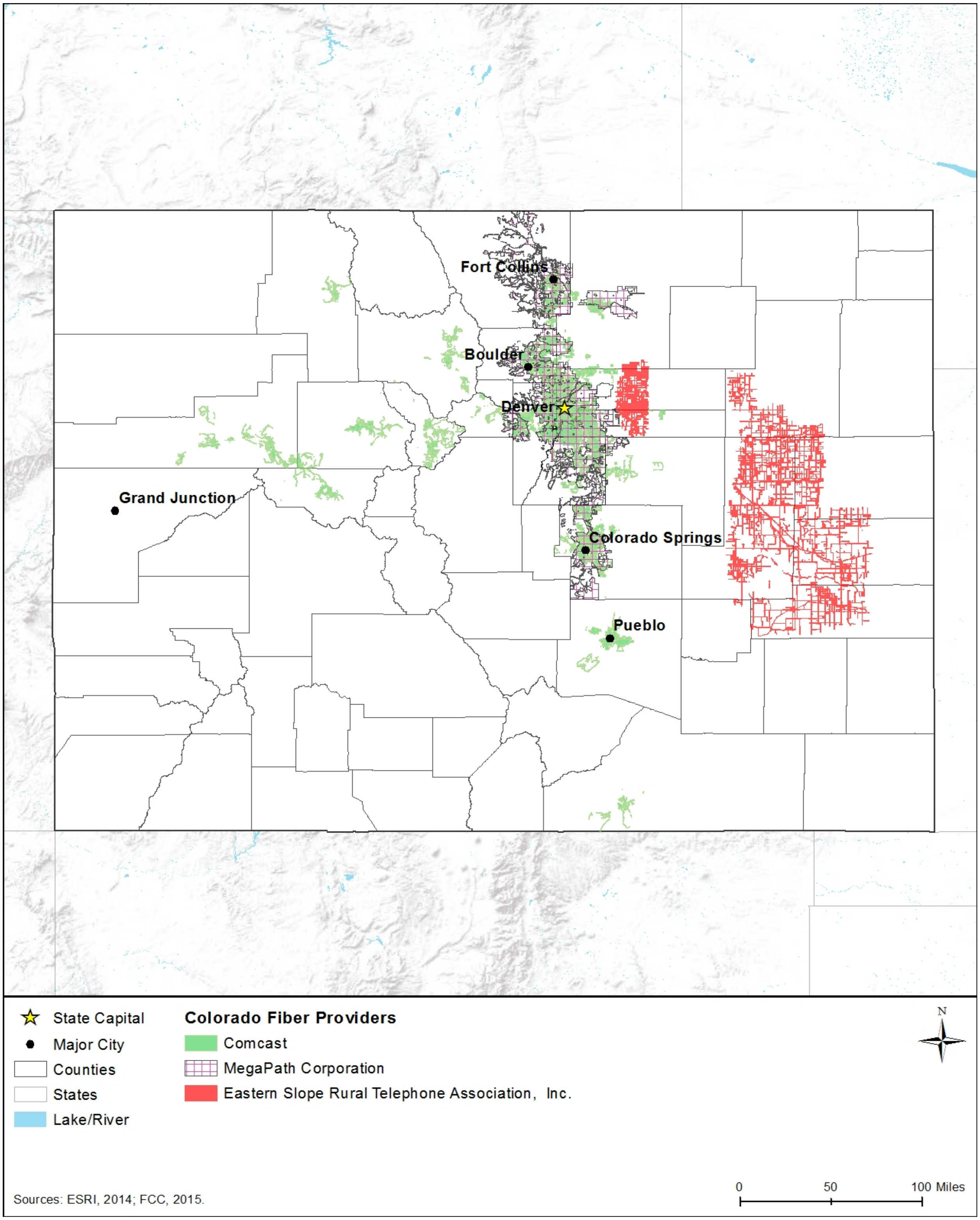

Figure 3.1.1-15: Megapath, Comcast, and Eastern Slope Rural Telephone Association Fiber Availability in Colorado

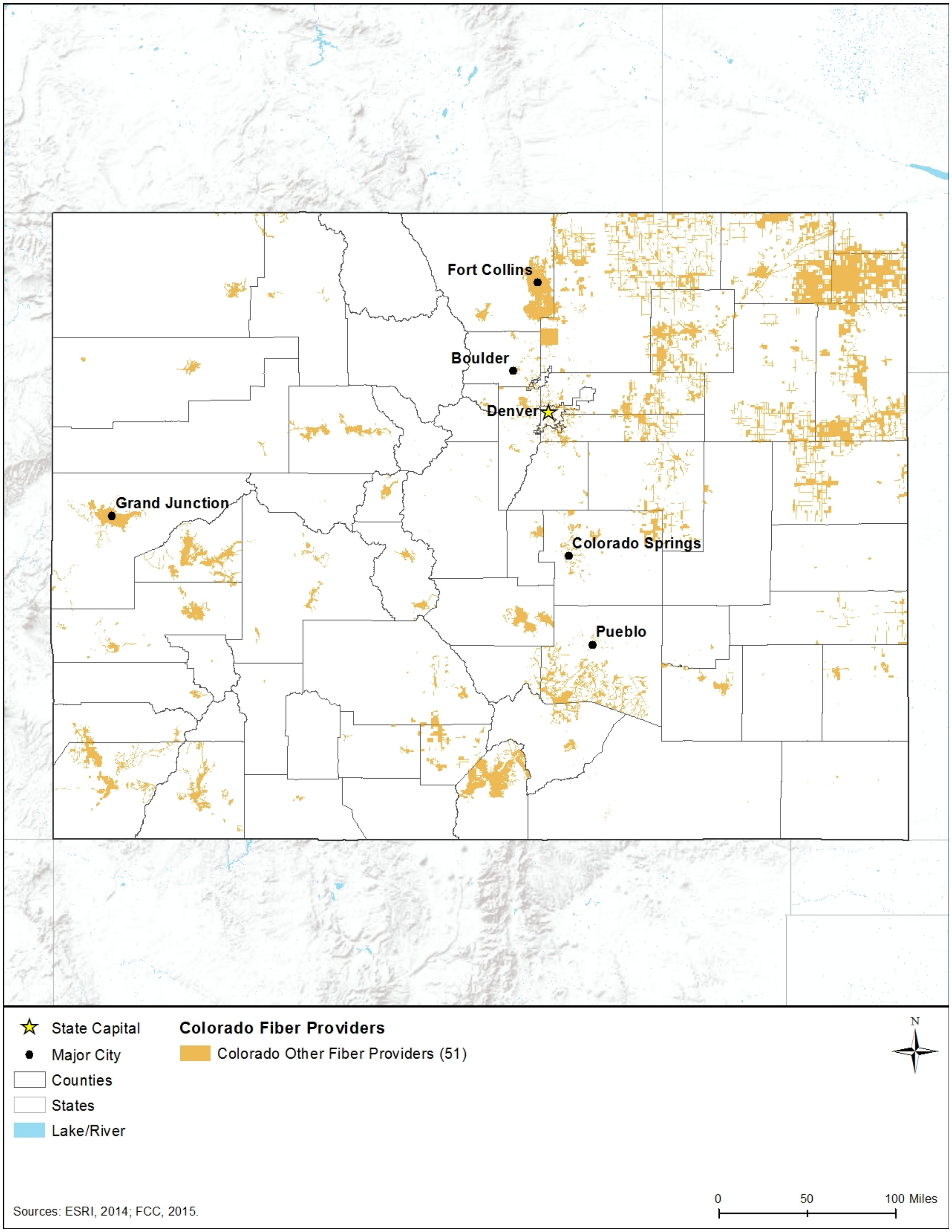

Figure 3.1.1-16: Other Fiber Providers Availability in Colorado

Data Centers

Data centers (also known as network access points, collocation facilities, hosting centers, carrier hotels, and Internet exchanges) are large telecommunications facilities that house routers, switches, servers, storage, and other telecommunications equipment. These data centers facilitate efficient network connectivity among and between telecommunications carriers and between carriers and their largest customers. These facilities also provide racks and cages for equipment, power and cooling, cabling, physical security, and 24x7 monitoring (CIO Council, 2015; GAO, 2013). Ownership of data centers may be public or private; comprehensive information regarding data centers may not be publicly available as some are related to secure facilities.

3.1.1.6. Utilities

Utilities are the essential systems that support daily operations in a community and cover a broad array of public services, such as electricity, water, wastewater, and solid waste. Section 3.1.4, Water Resources, describes the potable water sources in the state.

Electricity

In the state of Colorado, investor-owned electric utilities are regulated by the state's Public Utilities Commission (PUC). Their regulatory responsibilities include setting rates fair to both the customer and the utility, ensuring reliable service, and issuing certificates that allow operation in the state. There are two investor-owned utilities and one co-op that fall under the PUC regarding billing rates and service quality. Contrasting this, the PUC "has partial regulatory authority over municipal electric utilities, and 24 electric cooperative associations" (PUC, 2015a). This amounts to the PUC having some measure of authority over a total of 48 active electricity providers (PUC, 2015b). The vast majority of Colorado's electricity is generated from either coal or natural gas (EIA, 2015a). In 2015, coal generated 32,544,849 megawatthours (MWh)[14] of power; accounting for 60 percent of the total 53,847,386 MWh generated that year. Natural gas generated 11,953,808 MWh, or 22.2 percent of the total. In addition to these, 7,621,679 megawatts, or 14.1 percent, came from wind and solar power (EIA, 2016a). These are trends have held true for several years. As an example, in 2007, coal generated 66.6 percent of the state's electricity and natural gas produced 27.8 percent. However, during that time period, renewable sources accounted for only 5.7 percent (EIA, 2016a).

Growth in areas of renewable power are driven in part by goals set forth by the state's Renewable Energy Standard, aiming to have investor-owned electric utilities generate 30 percent of their output from renewable sources by 2020. As of 2012, the state had the ninth largest "grid-connected photovoltaic capacity" in the country (EIA, 2014a). Photovoltaics refer to solar panels that convert light into electricity (EIA, 2015b). Between 2012 and 2013, generation of solar power in Colorado increased 20 percent (EIA, 2014a). Energy consumption in Colorado is

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

split almost evenly between the industrial and transportation sectors, consuming 28.2 percent and 27.4 percent of the state's power, respectively. Residential customers consume 25.0 percent of the state's energy and commercial customers account for the remaining 19.4 percent (EIA, 2014a).

Water

The Colorado PUC oversees several aspects of the relationship between investor-owned water companies and their customers. Among their responsibilities are the regulation of utility rates and service standards regarding customers. The PUC also handles the compliance of investor-owned utilities regarding state and national standards (PUC, 2015c). These investor-owned utilities must be authorized to operate in the state; a process handled through the application of a Certificate of Public Convenience and Necessity, which are issued by the PUC (PUC, 2015c). There are only two active water utilities included in the PUC's list of service providers (PUC, 2015b). While it does exercise authority over investor-owned utilities, the PUC has no jurisdiction over municipal systems or their overarching bodies; such as the Water Districts (PUC, 2015c). Problems involving municipal water systems are handled by the city that operates the system (PUC, 2015d). The quality of drinking water is regulated through the Colorado Department of Public Health and Environment (CDPHE). Among other things, the Department certifies facility operators, reviews the design of proposed water facilities, and provides information on the source of the state's drinking water (CDPHE, 2015a). All public water systems in the state that service residential customers must complete a yearly report detailing treatment processes, current or potential contaminants and their sources, and the source of the water. These reports can be obtained directly from the water system's owner (CDPHE, 2015b).

Wastewater

Many aspects of the operation of wastewater treatment facilities are handled by the Colorado Department of Public Health and Environment (CDPHE). The Department's responsibilities include the certification of all wastewater treatment facility operators; a process largely handled through the Operator Certification Program Office, a designee of CDPHE (CDPHE, 2015c). The CDPHE also maintains records of operators and facilities as well as handling the preparation and distribution of annual reports (CDPHE, 2015r). The Department requires their Engineering Section to review the design of new wastewater treatment facilities, as well as reviewing changes to the design of existing facilities. This function is required by the state's Primary Drinking Water Regulations and its Water Quality Control Act (CDPHE, 2015e). Aside from certification and regulatory oversight, management of wastewater services is largely handled by individual local governments (DOLA, 2015). In some cases, individuals will have onsite wastewater treatment systems, otherwise known as septic systems. Large systems with flows "equal to or greater than 2,000 gallons per day" need approval from the CDPHE. Systems will flows less than "2,000 gallons per day" are subject to permitting and regulation by their local, county, or government authority. These local governments maintain regulations that meet or exceed the expectations of Regulation 43, "On-Site Wastewater Treatment System Regulation" (CDPHE, 2015f).

Solid Waste Management

Colorado is home to a number of waste management facilities. Among these are 63 active landfills that accept waste from the public at large (CDPHE, 2014a). There are also 28 commercial composting facilities (CDPHE, 2015g). Fifty-two transfer stations exist that accept material from the public (CDPHE, 2015h). In addition to these, the state of Colorado has 160 recycling facilities, many of them devoted to municipal waste (CDPHE, 2015i). In 2014, the state generated 9.9 billion kgs of waste, of which 7.7 billion kgs was generated from municipal sources. Of this, 38.2 percent, or 3.8 billion kgs was diverted from landfills through recycling, composting, or other means (CDPHE, 2015j). This left 6.4 billion kgs of waste to be disposed of in state landfills. This number was the same in 2013, but was an increase from previous years, where landfills accepted 5.6 and 5.7 billion kgs of waste in 2012 and 2011, respectively (CDPHE, 2015k).

The state also maintains programs for the disposal or reuse of waste tires, asbestos, paint, and waste grease, as well as more potentially hazardous materials such as electronic and medical waste (CDPHE, 2015l).

3.1.2. Soils

3.1.2.1. Definition of the Resource

The Soil Science Society of America defines soil as:

(i) "The unconsolidated mineral or organic material on the immediate surface of the Earth that serves as a natural medium for the growth of land plants." (NRCS, 2015a)

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

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

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

3.1.2.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of the National Environmental Policy Act (NEPA) and other applicable laws and regulations. Applicable federal laws and regulations that apply for Soils, such as the Farmland Protection Policy Act of 1981, are in Section 1.8, Overview of Relevant Federal Laws and Executive Orders, and Appendix C, Environmental Laws and Regulations. A list of applicable state laws and regulations is included in Table 3.1.2-1 below.

Table 3.1.2-1: Relevant Colorado Soil Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Colorado Department of Public Health and Environment – Stormwater Management Plan Preparation Guidance	Colorado Department of Public Health and Environment	Construction activities disturbing one acre or more are required to have stormwater Best Management Practices, including erosion and sediment control

3.1.2.3. Environmental Setting

Colorado is composed of four Land Resource Regions (LRR),[15] as defined by the National Resources Conservation Service (NRCS) (NRCS, 2006):

- Central Great Plains Winter Wheat and Range Region
- Rocky Mountain Range and Forest Region
- Western Great Plains Range and Irrigated Region
- Western Range and Irrigated Region

Within and among Colorado's four LRRs are 15 Major Land Resource Areas (MLRA),[16] which are characterized by patterns of soils, climate, water resources, land uses, and types of farming. The locations and characteristics of Colorado's MLRAs are presented in Figure 3.1.2-1 and Table 3.1.2-2, respectively.

Soil characteristics are an important consideration for FirstNet insomuch as soil properties could influence the suitability of sites for network deployment. Soil characteristics can differ over relatively short distances, reflecting differences in parent material, elevation, and position on the landscape, biota[17] such as bacteria, fungi, biological crusts, vegetation, animals, and climatic variables such as precipitation and temperature. For example, expansive soils[18] with wet and dry

[15] Land Resource Region: "A geographical area made up of an aggregation of Major Land Resource Areas (MLRA) with similar characteristics" (NRCS, 2006).
[16] 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).
[17] The flora and fauna of a region.
[18] 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 et al., 2004).

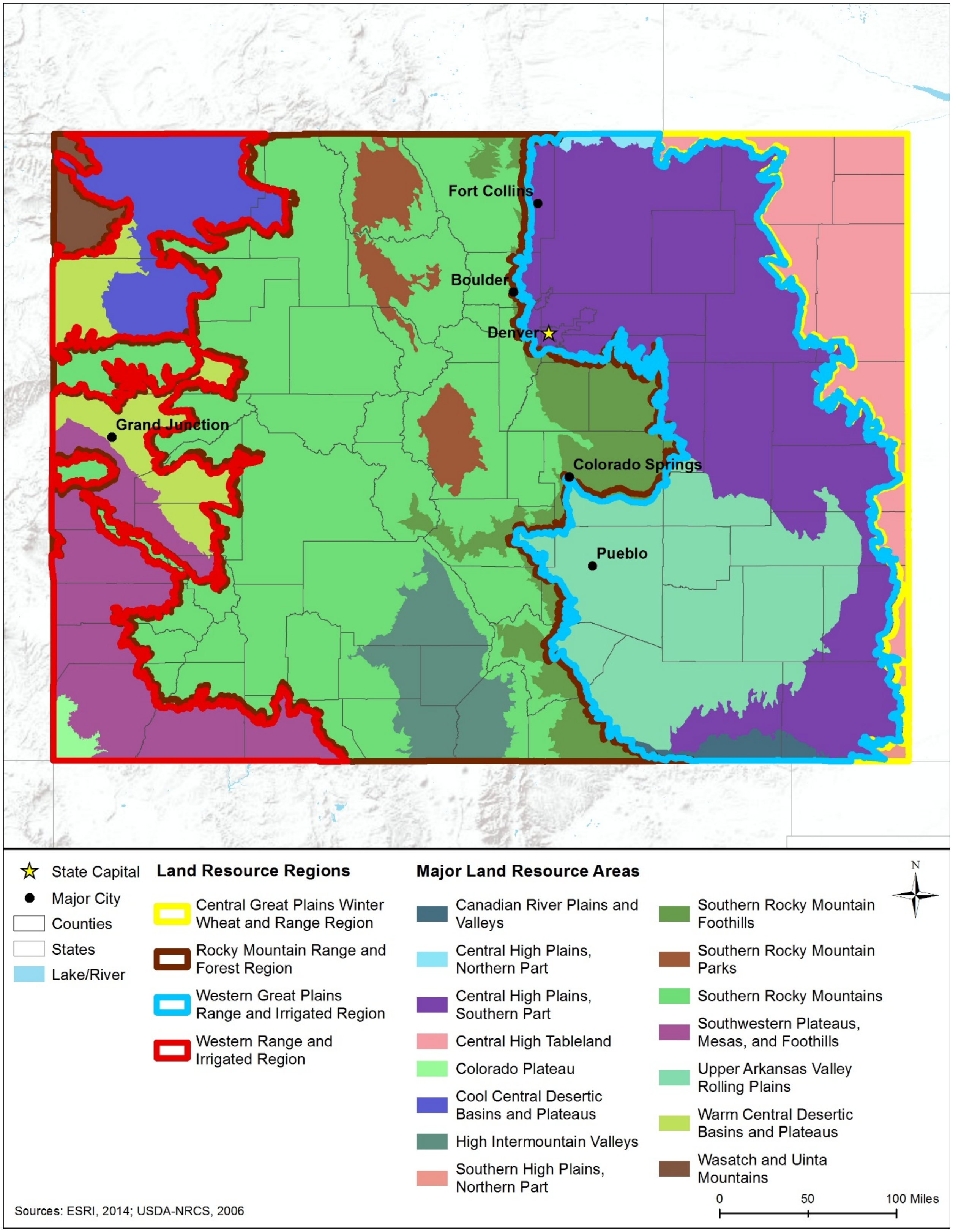

Figure 3.1.2-1: Locations of Major Land Resource Areas in Colorado

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

MLRA Name	Region of State	Soil Characteristics
Canadian River Plains and Valley	Southeastern Colorado	Alfisols,[19] Entisols,[20] and Mollisols[21] are the dominant soil orders. These well-drained soils are moderately textures or fine textured and range from shallow to deep.
Central High Plains, Northern Part	Northern Colorado	Entisols and Mollisols are the dominant soil orders. These soils are typically sandy or loamy[22] and range from shallow to moderately deep. They range from well drained (mostly) to poorly drained.
Central High Plains, Southern Part	Eastern Colorado	Alfisols, Aridisols,[23] Entisols, and Mollisols are the dominant soil orders. These typically well-drained soils are loamy or clayey and range from very shallow to very deep.
Central High Tableland	Eastern Colorado	Entisols and Mollisols are the dominant soil orders. These typically very deep soils are moderately well drained to excessively drained and vary in texture.
Colorado Plateau	Southwestern Colorado	Alfisols, Aridisols, Entisols, and Mollisols are the dominant soil orders. These loamy or clayey soils are typically well drained or somewhat excessively drained. They range from very shallow to very deep.
Cool Central Desertic Basins and Plateaus	Northwestern Colorado	Aridisols and Entisols are the dominant soil orders. These typically well-drained soils are "shallow or moderately deep to shale or sandstone bedrock."
High Intermountain Valleys	Southern Colorado	Aridisols and Entisols are the dominant soil orders. These soils have varied texture and range from somewhat poorly drained to somewhat excessively drained. They are typically deep or very deep.
Southern High Plains, Northern Part	Southeastern Colorado	Alfisols and Mollisols are the dominant soil orders. These loamy soils are typically well drained and very deep.
Southern Rocky Mountain Foothills	Eastern Colorado	Alfisols, Entisols, Inceptisols,[24] and Mollisols are the dominant soil orders. These soils are generally well drained and loamy or clayey. They range from very shallow to very deep.

[19] Alfisols: "Soils found in semiarid to moist areas that are formed from weathering processes that leach clay minerals and other constituents out of the surface layer and into the subsoil. They are productive for most crop, are primarily formed under forest or mixed vegetative cover, and make up nearly 10% of the world's ice-free land surface." (NRCS, 2015g)
[20] Entisols: "Soils that show little to no pedogenic horizon development. They occur in areas of recently deposited parent materials or in dunes, steep slopes, or flood plains where erosion or deposition rates are faster than rate of soil development. They make up nearly 16% of the world's ice-free land surface." (NRCS, 2015g)
[21] 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, 2015g)
[22] Loamy Soil: "[A soil] that combines [sand, silt, and clay] in relatively equal amounts." (Purdue University Consumer Horticulture, 2006)
[23] Aridisols: "Soils that are too dry for the growth of mesophytic plants. Lack of moisture greatly restricts the intensity of the weathering process and limits most soil development processes to the upper part of the soils. They make up about 12% of the world's ice-free land surface."
[24] Inceptisols: "Soils found in semiarid to humid environments that exhibit only moderate degrees of soil weathering and development. They have a wide range of characteristics, can occur in a wide variety of climates, and make up nearly 17% of the world's ice-free land surface." (NRCS, 2015g)

MLRA Name	Region of State	Soil Characteristics
Southern Rocky Mountain Parks	Central Colorado	Mollisols is the dominant soil order, with Alfisols less so. These typically well-drained soils range from very shallow to very deep, and are loamy or clayey.
Southern Rocky Mountains	Central Colorado	Alfisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders.
Southwestern Plateaus, Mesas, and Foothills	Southwestern Colorado	Alfisols, Aridisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These soils range from shallow to very deep and are loamy, clayey, or silty.
Upper Arkansas Valley Rolling Plains	Eastern Colorado	Alfisols, Aridisols, and Entisols are the dominant soil orders. These typically well-drained soils range from very shallow to very deep and are loamy or clayey.
Warm Central Desertic Basins and Plateaus	Western Colorado	Aridisols and Entisols are the dominant soil orders, with Mollisols present at higher elevations. These typically well-drained soils are "shallow or moderately deep to shale or sandstone bedrock."
Wasatch and Uinta Mountains	Northwestern Colorado	Aridisols, Entisols, Inceptisols, and Mollisols are the dominant soil orders. These typically well-drained soils range from very shallow to very deep and are loamy or loamy-skeletal.

Source: (NRCS, 2006)

seasons alternately swell and shrink, which presents integrity risks to structural foundations (Rogers et al., 2004). Soils can also be affected by a variety of surface uses that loosen topsoil and damage or remove vegetation or other groundcover, which may result in accelerated erosion, compaction, and rutting[25] (discussed further in the subsections below).

3.1.2.4. Soil Suborders

Soil suborders are part of the soil taxonomy[26] (a system of classification used to make and interpret soil surveys). Soil orders are the highest level in the taxonomy; there are 12 soil orders in the world and they are characterized by both observed and inferred[27] 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, 2015b). The STATSGO2[28] soil database identifies 21 different soil suborders in Colorado (NRCS, 2015c). Figure 3.1.2-2 depicts the distribution of the soil suborders, and Table 3.1.2-3 provides a summary of the major physical-chemical characteristics of the various soil suborders found.

[25] Rutting is indentations in soil from operating equipment in moist conditions or soils with lower bearing strength. (USFS, 2009b)
[26] Science of naming and classifying organisms or specimens.
[27] "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, 2015b)
[28] STATSGO2 is the Digital General Soil Map of the U.S. that shows general soil association units across the landscape of the nation. Developed by the National Cooperative Soil Survey, STATSGO2 supersedes the State Soil Geographic (STATSGO) dataset.

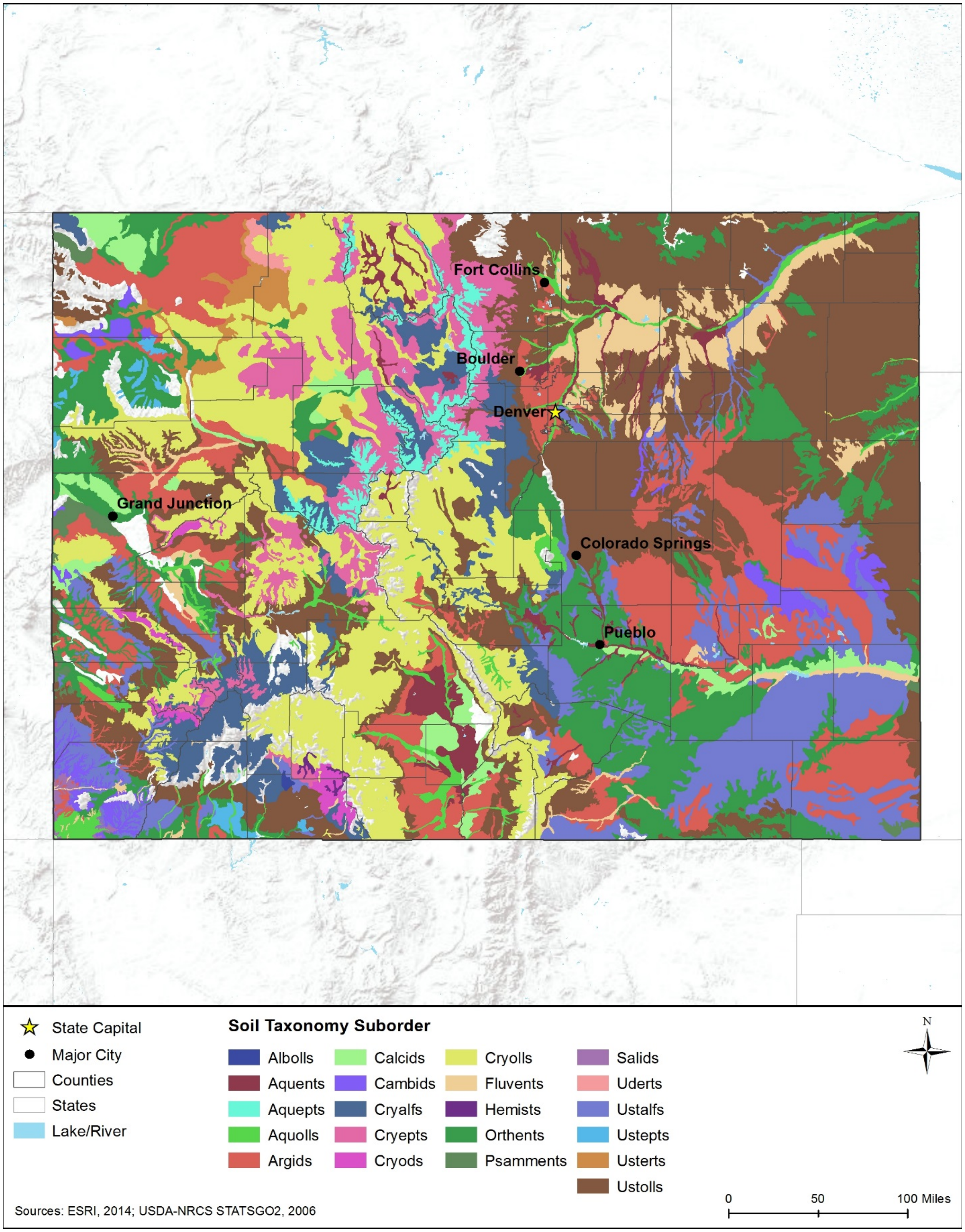

Figure 3.1.2-2: Colorado Soil Taxonomy Suborders

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

Soil Order	Soil Suborder	Ecological Site Description	Soil Texture	Slope (%)	Drainage Class	Hydric Soil[b]	Hydrologic Group	Runoff Potential[c]	Permeability	Erosion Potential	Compaction and Rutting Potential
Mollisols	Albolls	Albolls have a fluctuating ground=water table, with gentle slopes. They supported grasses and shrubs, and are typically used as cropland.	Weathered bedrock	4-25	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Aquents	Widely distributed, with some forming in sandy deposits, and most forming in recent sediments. Aquents support vegetation that tolerates either permanent or periodic wetness, and are mostly used for pasture, cropland, forest, or wildlife habitat.	Gravelly loam, loam, stratified loamy sand to loam, stratified sandy loam to clay loam, variable, very gravelly sand	0-6	Poorly drained to somewhat poorly drained	Yes, No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	High, due to hydric soil and poor drainage conditions
Inceptisols	Aquepts	Aquepts have poor or very poor natural drainage. If these soils have not been artificially drained, 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.	Stony sandy loam	0-3	Somewhat poorly drained	Yes	C	Medium	Low	Medium, depending on slope	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.	Gravelly sandy loam, loam, silty clay loam, very fine sandy loam, very gravelly loamy coarse sand	0-10	Poorly drained to well drained	Yes, No	B, C, D	Medium, High	Moderate, 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.	Clay, clay loam, coarse sandy loam, fine sandy loam, gravelly loam, gravelly sandy clay loam, loam, loamy sand, sand, sandy clay loam, sandy loam, very fine sandy loam, very gravelly loamy coarse sand	0-50	Moderately well drained to somewhat excessively drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
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.	Fine sandy loam, gravelly fine sandy loam, gravelly sandy loam, loam, sandy loam, weathered bedrock	0-40	Moderately well drained to well drained	No	B, C	Medium	Moderate, Low	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.	Clay loam, fine sandy loam, silty clay, very fine sandy loam, weathered bedrock	0-20	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Alfisols	Cryalfs	Cryalfs are cold weather soils found primarily at high elevations. Due to the cold, short growing season, the majority of these soils are utilized as forest.	Gravelly fine sandy loam, gravelly loam, gravelly sandy loam, loam, sandy clay loam, slightly decomposed plant material, stony clay loam, very gravelly clay loam, very gravelly sandy loam, very stony fine sandy loam	4-90	Well drained	No	B, C, D	Medium, High	Moderate, Low, Very Low	Medium to High, depending on slope	Low
Inceptisols	Cryepts	Cryepts are soils of high latitudes or high elevations, and support cold weather vegetation such as conifers and hardwoods. They are mostly used as forest or wildlife habitat, although some are also used as cropland.	Cobbly sandy loam, extremely stony loam, extremely stony sandy loam, fine sandy loam, gravelly sandy loam, sandy loam, silty clay loam	3-99	Somewhat excessively drained to well 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[c]	Permeability	Erosion Potential	Compaction and Rutting Potential
Spodosols	Cryods	Cryods are soils of high latitudes and/or high elevations, with coniferous forest vegetation, and are used as forest or wildlife habitat.	Loam, weathered bedrock	4-60	Well drained	No	B	Medium	Moderate	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.	Clay loam, cobbly clay, cobbly loam, extremely channery[d] sandy loam, extremely stony loam, fine sandy loam, gravelly clay loam, gravelly loam, gravelly sandy loam, loam, sandy clay loam, sandy loam, silt loam, unweathered bedrock, very channery sandy clay loam, very cobbly clay loam, very cobbly sandy loam, very fine sandy loam, very gravelly sand, very gravelly sandy loam, very stony loamy sand	0-75	Excessively drained to well drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low 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.	Fine sand, fine sandy loam, loam, loamy fine sand, sandy loam, silt loam, silty clay loam, stratified sand to loamy fine sand, stratified sand to very gravelly sand, variable	0-6	Excessively drained to somewhat poorly drained	No	A, B, C	Low, Medium	High, Moderate, Low	Low to Medium, depending on slope	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.	Peat	0-12	Poorly drained	Yes	D	High	Very Low	High	High, due to hydric soil and poor drainage conditions
Entisols	Orthents	Orthents are commonly found on recent erosional surfaces and are used primarily as rangeland, pasture, or wildlife habitat.	Clay, clay loam, gravelly coarse sandy loam, gravelly loam, loam, sandy clay loam, sandy loam, silt loam, silty clay loam, very channery clay loam, very gravelly clay loam, very gravelly sand, weathered bedrock,	0-90	Somewhat excessively drained to somewhat poorly drained	No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	Low
Entisols	Psamments	Psamments are sandy in all layers. In some arid and semi-arid climates, they are among the most productive rangeland soils, and are primarily used as rangeland, pasture, or wildlife habitat. Those Psamments that are nearly bare are subject to wind erosion and drifting, and do provide good support for wheeled vehicles.	Loamy fine sand, loamy sand, sand	1-30	Somewhat excessively drained to excessively drained	No	A	Low	High	Low	Low
Aridisols	Salids	Salids are primarily found in Nevada and Utah, and commonly located in depressions (playas). They have a saline horizon that makes them unsuitable for agricultural use unless they are leached of salts. Therefore, most of these soils are utilized for wildlife habitat or rangeland.	Clay loam	3-12	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[c]	Permeability	Erosion Potential	Compaction and Rutting Potential
Vertisols	Uderts	Uderts are found in humid areas, and primarily used as cropland, forest, or pasture. They have low permeability, and water usually must be drained from the surface of cropland.	Clay loam	10-40	Moderately well drained	No	D	High	Very Low	High	Low
Alfisols	Ustalfs	Ustalfs are primarily used for grazing or cropland, and they support savanna and grassland vegetation. They are found in areas with a marked dry season.	Clay, clay loam, fine sandy loam, loam, loamy fine sand, sandy loam, silt loam, silty clay loam, unweathered bedrock, very cobbly sandy clay loam, very gravelly clay loam, very gravelly sand	0-80	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Inceptisols	Ustepts	Ustepts are freely drained soils, typically used as pasture or cropland, although some support forest, rangeland, and wildlife habitat.	Clay loam, loam	1-80	Well drained	No	B, C	Medium	Moderate, Low	Medium	Low
Vertisols	Usterts	Usterts are soils with low permeability, and receive low rainfall amounts. They support grasses and forbs, and are mostly used for rangeland or cropland. However, but due to their low permeability, they typically need to be artificially drained if irrigated, to prevent standing water and a buildup of salinity.	Clay	3-35	Well drained	No	D	High	Very Low	High	Low
Mollisols	Ustolls	Ustolls typically supported grass and forest vegetation, and are now primarily used as cropland or rangeland. They are generally freely drained, and found in subhumid to semiarid climates. Areas with drought are common, and blowing soil can be an issue.	Clay, clay loam, fine sandy loam, gravelly loam, gravelly sandy loam, loam, loamy fine sand, loamy sand, sandy clay loam, sandy loam, silt loam, silty clay loam, stratified sand to clay loam, unweathered bedrock, very channery loam, very cobbly clay loam, very fine sandy loam, very gravelly loam, very gravelly loamy sand, very gravelly sandy loam, very stony fine sandy loam, very stony sandy clay loam, weathered bedrock	0-90	Somewhat poorly drained to somewhat excessively drained	Yes, No	A, B, C, D	Low, Medium, High	High, Moderate, Low, Very Low	Low to High, depending on slope	High, due to hydric soil and poor drainage conditions

[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, 2015d). Soil suborders constitute a broad range of soil types. Within each soil suborder, some specific soil types are hydric while others are not.
[c] Based on Runoff Potential, described in Section 3.1.2.5.
[d] Channery: An accumulation of thin, flat, course fragments of sandstone, limestone of schist up to 6 inches. (University of Delaware, 2016)

Sources: (NRCS, 2015c) (NRCS, 1999)

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3.1.2.5. Runoff Potential

The NRCS uses four Hydrologic Soil Groups (A, B, C, and D) that are based on a soil's runoff potential.[29] Group A generally has the smaller runoff potential, whereas Group D generally has the greatest (Purdue University, 2015). Table 3.1.2-3 (above) provides a summary of the runoff potential for each soil suborder in Colorado.

Group A. **Sand, loamy sand or sandy loam soils.** This group of soils has "low runoff potential and high infiltration rates[30] 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). Cryepts, Cryolls, Fluvents, Orthents, Psamments, and Ustolls fall into this category in Colorado.

Group B. **Silt loam or loam soils.** This group of soils has a "moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures" (Purdue University, 2015). This group has medium runoff potential. Aquents, Aquolls, Argids, Calcids, Cambids, Cryalfs, Cryepts, Cryods, Cryolls, Fluvents, Orthents, Ustalfs, Ustepts, and Ustolls fall into this category in Colorado.

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. Aquents, Aquepts, Aquolls, Argids, Calcids, Cambids, Cryalfs, Cryolls, Fluvents, Orthents, Ustalfs, Ustepts, and Ustolls, fall into this category in Colorado.

Group D. **Clay loam, silty clay loam, sandy clay, silty clay, or clay soils.** This group of soils "has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material" (Purdue University, 2015). Albolls, Aquents, Aquolls, Argids, Cambids, Cryalfs, Cryepts, Cryolls, Hemists, Orthents, Salids, Uderts, Usterts, and Ustolls fall into this category in Colorado.

3.1.2.6. Soil Erosion

"Soil erosion involves the breakdown, detachment, transport, and redistribution of soil particles by forces of water, wind, or gravity" (NRCS, 2015e). Water-induced erosion can transport soil into streams, rivers, and lakes, and degrade water quality and aquatic habitat. When topsoil is eroded, organic material is depleted, creating loss of nutrients available for plant growth. Soil

[29] 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.
[30] 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)

particles displaced by wind can cause human health problems and reduced visibility, creating a public safety hazard (NRCS, 1996a). Table 3.1.2-3 (above) provides a summary of the erosion potential for each soil suborder in Colorado. Soils with medium to high erosion potential in Colorado include those in the Albolls, Aquents, Aquepts, Aquolls, Argids, Calcids, Cambids, Cryalfs, Cryepts, Cryods, Cryolls, Fluvents, Hemists, Orthents, Salids, Uderts, Ustalfs, Ustepts, Usterts, and Ustolls suborders, which are found throughout the entire state (Figure 3.1.2-2).

3.1.2.7. Soil Compaction and Rutting

Soil compaction and rutting occurs when soil layers are compressed by machinery or animals, which decreases both open spaces in the soil, as well as water infiltration rates (NRCS, 1996b). Moist soils with high soil water content are most susceptible to compaction and rutting, as they lack the strength to resist deformation caused by pressure. When rutting occurs, channels form and result in downslope erosion (U.S. Forest Service, 2009). Other characteristics that factor into compaction and rutting risk include soil composition (i.e., low organic soil is at increased risk of compaction), amount of pressure exerted on the soil, and repeatability (i.e., the number of times the pressure is exerted on the soil). Machinery and vehicles that have axle loads greater than 10 tons can cause soil compaction of greater than 12 inches depth (NRCS, 1996b), (NRCS, 2003).

Loam, sandy loam, and sandy clay loam soils are most susceptible to compaction and rutting; silt, silty clay, silt loam, silty clay loam, and clay soils are more resistant to compaction and rutting (NRCS, 1996b). Table 3.1.2-3 provides a summary of the compaction and rutting potential for each soil suborder in Colorado. Soils with the highest potential for compaction and rutting in Colorado include those in the Albolls, Aquents, Aquepts, Aquolls, Hemists, and Ustolls suborders, which are found mostly in alpine environments, western, and northeastern areas of the state.

3.1.3. Geology

3.1.3.1. Definition of the Resource

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

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

- Section 3.1.3.3, Environmental Setting: Physiographic Regions and Provinces[31, 32]
- Section 3.1.3.4, Surface Geology
- Section 3.1.3.5, Bedrock Geology[33]
- Section 3.1.3.6, Paleontological Resources[34]
- Section 3.1.3.7, Fossil Fuel and Mineral Resources
- Section 3.1.3.8, Geologic Hazards[35]

3.1.3.2. Specific Regulatory Considerations

The Proposed Action must meet the requirements of NEPA and other applicable laws and regulations. A list of applicable state laws and regulations is included in Table 3.1.3-1 below.

Table 3.1.3-1: Relevant Colorado Geology Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Colorado Building Codes[36]	Local Agencies	Check county, city, and other local agencies for seismic guidelines in building codes.
Colorado Revised Statute (CRS) 24-80-401-411 Historical, Prehistorical, and Archaeological Resources[37]	Colorado Office of Archaeology and Historic Preservation	A permit (issued by the Colorado State Historical Society) is required for investigation, excavation, gathering, or removal of any paleontological resource. This applies to public lands, and can apply to private lands as well, within the state.

3.1.3.3. Environmental Setting: Physiographic Regions and Provinces

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

Colorado is composed of three physiographic regions: eastern Colorado falls within the Interior Plains Region (Great Plains Province); central Colorado is within the Rocky Mountain System (Southern Rocky Mountains, Wyoming Basin, and Middle Rocky Mountains Provinces); and

[31] Physiographic regions: Areas of the United States that share commonalities based on topography, geography, and geology. (Fenneman, N., 1916)
[32] Physiographic provinces: Subsets within physiographic regions. (Fenneman, N., 1916)
[33] Bedrock: Solid rock beneath the soil and superficial rock. (USGS, 2015i)
[34] Paleontology: “Study of life in past geologic time based on fossil plants and animals.” (USGS, 2015j)
[35] 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)
[36] (City of Fort Collins, 2014) (Arapahoe County, Colorado, 2015)
[37] (State of Colorado, 2006)

western Colorado is within the Intermontane Plateaus Region (Colorado Plateaus Province) (USGS, 2003a) (Figure 3.1.3-1). Colorado's physiography is discussed in greater detail below.

Interior Plains Region

The Interior Plains Region extends across much of the interior of the United States, roughly between the western edge of the Appalachian Highlands (near states including Ohio, Tennessee, and Alabama), and the eastern edge of the Rocky Mountain System (including states such as Montana, Wyoming, and Colorado) (Fenneman, N., 1916). Metamorphic and igneous rocks dating to the Precambrian Era (older than 542 million years ago (MYA)) underlie the entire region.[38] There is minimal topographic relief throughout the region, except for the Black Hills of South Dakota. During the Mesozoic Era, much of the Interior Plains were covered by the oceans, resulting in the formation of sedimentary rocks,[39] which lie on top of the Precambrian basement rocks. Erosion from the Rocky Mountains to the west and the Ozark/Ouachita Mountains to the east, also contributed to the formation of sandstone,[40] mudstone,[41] and clay (USGS, 2014a).

Great Plains Province – The Great Plains Province includes more than 450,000 square miles in the United States and encompasses the western portion of the Interior Plains Region. The Great Plains, which are the second largest physiographic province in the United States, are noted for their flat topography that is interrupted by the occasional hill or lowland. (USGS, 2003b) (NPS, 2014a)

Within Colorado, the Great Plains Province includes the entirety of the state east of the Rocky Mountain foothills. Elevations increase moving westward throughout the Great Plains, and reach roughly 5,000 to 7,000 feet above sea level (ASL) near the base of the Rocky Mountains in Colorado. Eastern Colorado is largely underlain by Tertiary (66 to 2.6 MYA) and Cretaceous (146 to 66 MYA) sedimentary rocks (USGS, 2003a).

[38] 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.
[39] Sedimentary Rock: "Rocks that formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding." (USGS, 2014f)
[40] Sandstone: "Sedimentary rock made mostly of sand-sized grains." (USGS, 2015h)
[41] Mudstone: "A very fine-grained sedimentary rock formed from mud." (USGS, 2015h)

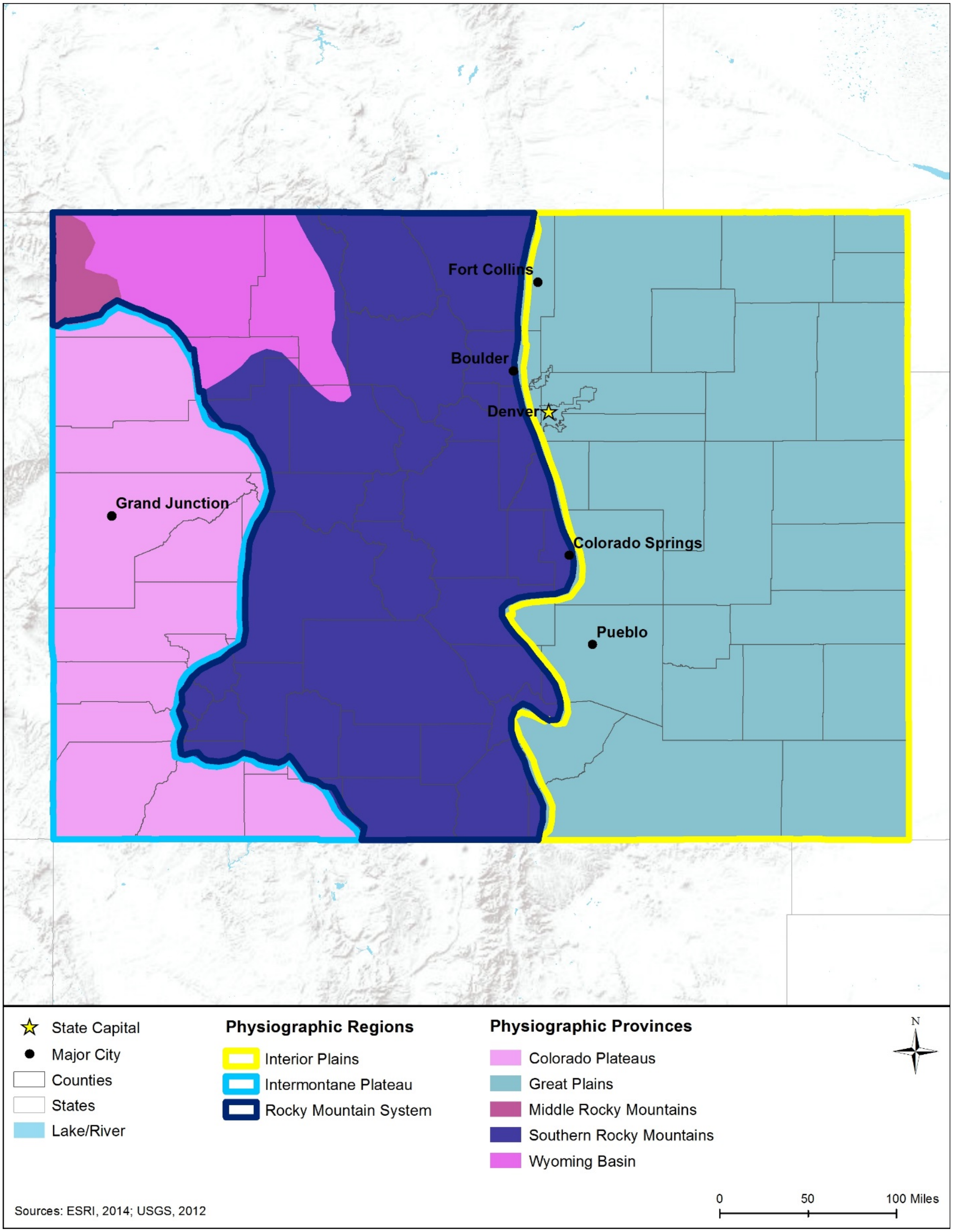

Figure 3.1.3-1: Physiographic Regions and Provinces of Colorado

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,[42] which occurred between 70 and 40 MYA. They formed due to the collision of the Pacific Ocean oceanic crust[43] 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, this resulted in formation of the Rocky Mountains several hundred miles further inland than is normally observed. (USGS, 2014b)

As reported above, the Rocky Mountain System Region within Colorado is composed of three physiographic provinces: the Southern Rocky Mountains, Wyoming Basin, and Middle Rocky Mountains Provinces (USGS, 2003b). Each province is discussed further below.

<u>Southern Rocky Mountains</u> – Within Colorado, the Southern Rocky Mountains Province includes the Front Range that runs north-south through west-central Colorado. The province is characterized by north-northwest-trending mountain ranges that span between 7,000 and 14,000 feet ASL. The province is underlain by igneous,[44] metamorphic,[45] and sedimentary rocks (Apodaca & Bails, 2000). "[Characteristic] structures of the Southern Rockies include anticlinal[46] arches and intermontane basins" (NPS, 2014b).

<u>Wyoming Basin</u> – The Wyoming Basin includes the area between the Middle Rocky Mountains and Southern Rocky Mountains. This province is characterized "an elevated depression with structural features dating back to the mountain building event that shaped the Rocky Mountains (the Laramide Orogeny). Characteristic features of the Wyoming Basin include hogbacks, cuestas, and numerous basins that are separated by mountains of varying size." (NPS, 2014b).

<u>Middle Rocky Mountains</u> – Within Colorado, the Middle Rocky Mountains includes a small portion of the extreme northwestern portion of the state. Folded sedimentary and volcanic mountains are characteristic of this province (NPS, 2014b).

Intermontane Plateau Region

The Intermontane Plateau Region describes the area between the Rocky Mountains and the Sierra Nevada and Cascade Ranges. The Intermontane Plateau Region dates to 80 million years ago (MYA) and predates the younger Rocky Mountain System to the east (which was created roughly 60 MYA). The region is characterized by interspersed higher-elevation plateaus and mountains and lower-lying basins. The Colorado Plateaus Province is one of the major elevated areas in this region (Lew, 2004).

[42] Orogeny: "An episode of mountain building and/or intense rock deformation." (USGS, 2015h)
[43] Crust: "The rocky, relatively low density, outermost layer of the Earth." (USGS, 2015h)
[44] Igneous Rock: "Rock formed when molten rock (magma) that has cooled and solidified (crystallized)." (USGS, 2015h)
[45] Metamorphic Rock: "A rock that has undergone chemical or structural changes produced by increase in heat or pressure, or by replacement of elements by hot, chemically active fluids." (USGS, 2015h)
[46] Anticline: "A downward-curving (convex) fold in rock that resembles an arch. The central part, being the most exposed to erosion, display the oldest section of rock." (USGS, 2015h)

Colorado Plateaus – The Colorado Plateaus Province includes much of western Colorado, including the area surrounding the Four Corners region. "Ancient volcanic mountains, plateaus, and buttes, deeply carved canyons, and amazing ranges in color are the region's defining characteristics" (NPS, 2014c). The province's plateaus are roughly 5,000 to 7,000 feet ASL, with the bottoms of the carved valleys at roughly 2,000 feet ASL. The highest mountain peaks in the province are roughly 13,000 feet ASL (NPS, 2014c).

3.1.3.4. Surface Geology

Surficial geology is characterized by materials such as till,[47] sand and gravel, or clays that overlie bedrock. The surface terrain, which can include bedrock outcrops, provides information on the rock compositions and structural characteristics of the underlying geology. Because surface materials are exposed, they are subject to physical and chemical changes due to weathering from precipitation (rain and snow), wind and other weather events, and human-caused interference. Depending on the structural characteristics and chemical compositions of the surface materials, heavy precipitation can cause slope failures,[48] subsidence,[49] and erosion. (Thompson, 2015)

Surface deposits in Colorado are largely attributable to one of two sources: glaciers and wind-blown sand dunes. Glacial deposits, which emanated from the most recent Ice Age (which ended 13,000 years ago) are found within portions of Colorado within the Rocky Mountain System (Colorado Geological Survey, 2015d); much of the landscape within the higher elevations of Rocky Mountains was shaped by Ice Age glaciers and those glaciers that remain today (Pierce, K., 2003). Roughly 12 glaciers remain in Colorado today (Colorado Geological Survey, 2015d). Within the Colorado portions of the Great Plains Province, there are more than 30,000 miles of eolian[50] deposits. Some of the tallest sand dunes nationwide are within Great Sand Dunes National Park and Preserve and measure over 700 feet tall (Colorado Geological Survey, 2015g). Stream terrace deposits, Piedmont gravels,

Image of Great Sand Dunes National Park and Preserve (Colorado)

Source: (NPS, 2015g)

[47] Till: "An unsorted and unstratified accumulation of glacial sediment, deposited directly by glacier ice. Till is a heterogeneous mixture of different sized material deposited by moving ice (lodgement till) or by the melting in-place of stagnant ice (ablation till). After deposition, some tills are reworked by water." (USGS, 2013b)
[48] 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)
[49] Subsidence: "Gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." (USGS, 2000)
[50] Eolian: "Term describing the process of wind erosion, transport, and deposition, and wind-created deposits and structures such as sand dunes." (USGS, 2015h)

landslide deposits, colluvium,[51] alluvium,[52] and volcanic deposits are also found throughout portions of the state (USGS, 2015a).

Figure 3.1.3-2 illustrates the generalized surface geology throughout Colorado.

3.1.3.5. 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., 3-dimensional geometry), including dip (slope of the formation),[53] rock composition, and regional tectonism.[54] These structural aspects of bedrock geology are often indicative of regional stability, as it relates to geologic hazards such as landslides, subsidence, earthquakes, and erosion (NHDES, 2014).

Within Colorado, the Great Plains Province is primarily underlain by: unconsolidated Quaternary deposits (see Section 3.1.3.4, Surface Geology); sedimentary rocks from the Tertiary Period (66 to 2.6 MYA); and sedimentary rocks of the Mesozoic Era (251 to 66 MYA). The Rocky Mountains are composed of: volcanic and intrusive[55] igneous rocks of the Cenozoic Era (66 MYA to present) (Colorado Geological Survey, 2015h) (University of California Museum of Paleontology, 2011). Within southwestern Colorado, many of volcanic "Many of these rocks originated in the San Juan volcanic field, which is in the southwestern region of the state. There, many large caldera eruptions generated phenomenal amounts of pyroclastic debris (hundreds of cubic miles)" (Colorado Geological Survey, 2015j). Within the northern half of Colorado, the Rocky Mountains are made of sedimentary rocks of the Paleozoic Era; and igneous, metamorphic, and sedimentary rocks of the Precambrian Era (older than 542 MYA). The Colorado Plateau is dominated by sedimentary rocks of the Mesozoic Era (Colorado Geological Survey, 2015h). Figure 3.1.3-3 displays the general bedrock geology for Colorado. For more site-specific information, other sources from the Colorado Geological Survey should be consulted (Colorado Geological Survey, 2015i).

[51] Colluvium: "A general term applied to unconsolidated material deposited by rainwash or slow continuous downslope creep, usually collecting at the base of hillsides." (USGS, 2005)
[52] Alluvium: "A general term for unconsolidated sedimentary accumulations deposited by rivers or streams. It includes sediment deposited in river beds and flood plains." (USGS, 2005)
[53] 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)
[54] Tectonicisms: "Structure forces affecting the deformation, uplift, and movement of the earth's crust." (USGS, 2016e)
[55] Intrusive Rock: "Igneous rock that cools and solidifies beneath the Earth's surface." (NPS, 2000)

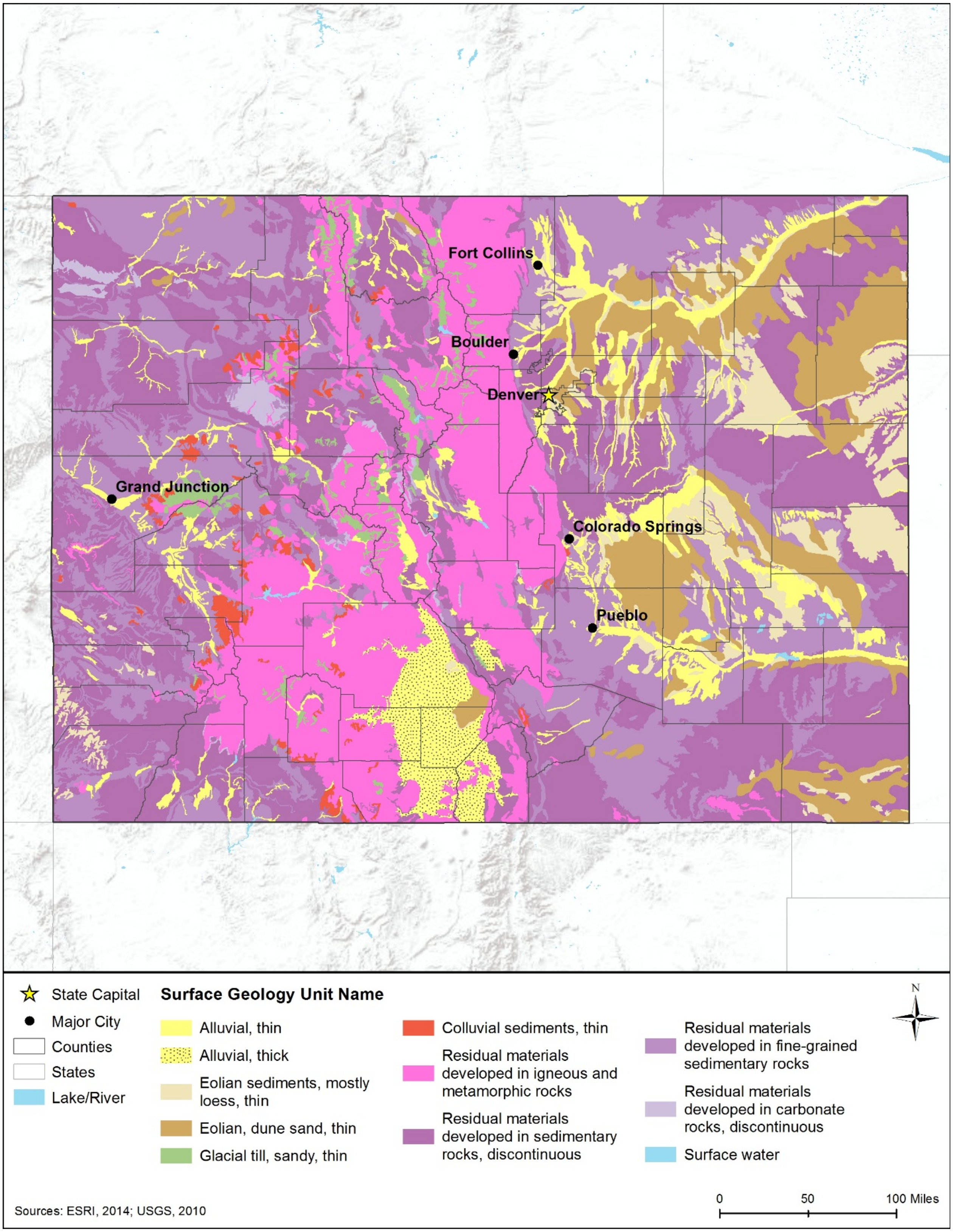

Figure 3.1.3-2: Generalized Surface Geology for Colorado

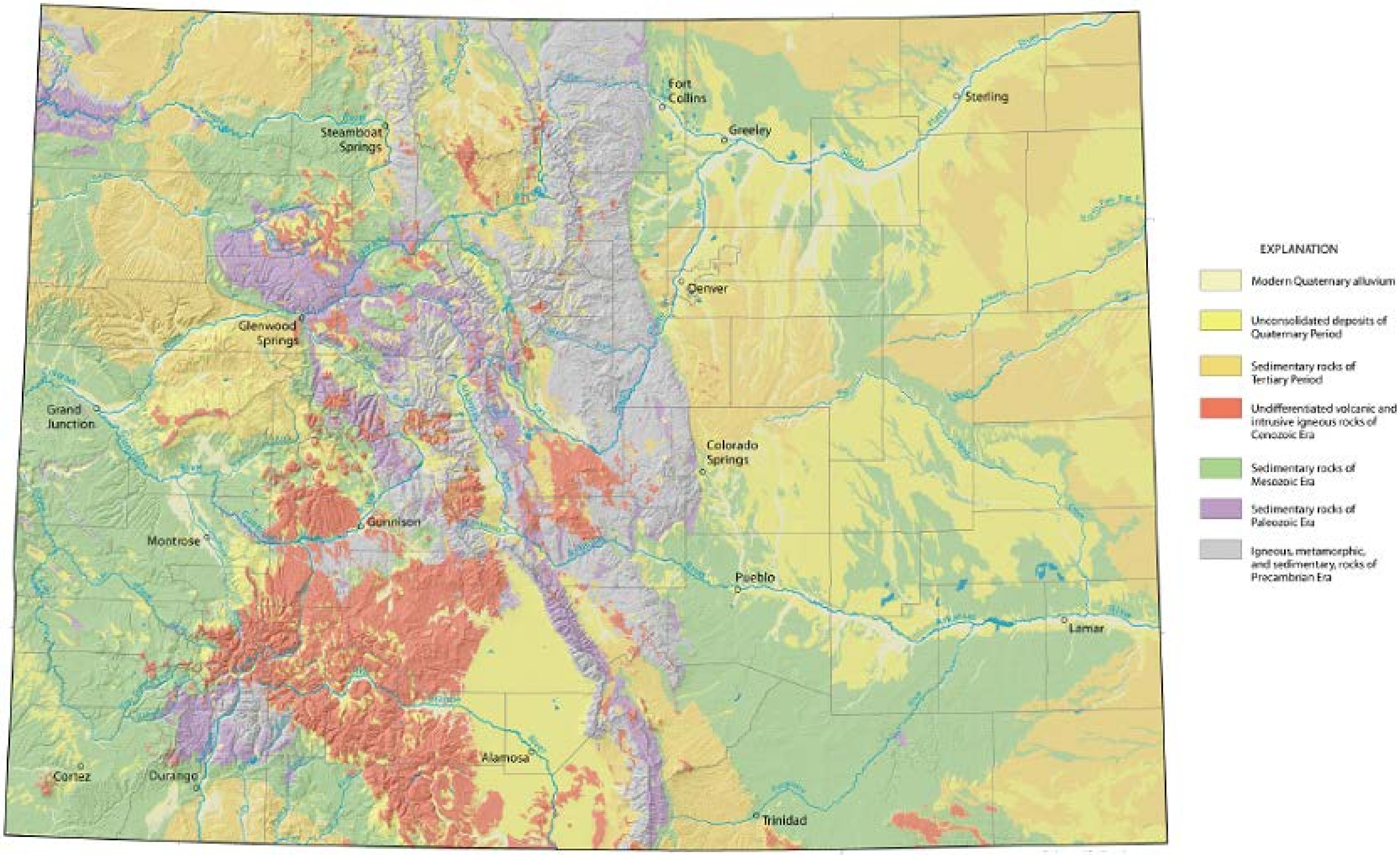

Figure 3.1.3-3: Generalized Bedrock Geology for Colorado

Source: (Colorado Geological Survey, 2015h)

3.1.3.6. Paleontological Resources

Fossil-bearing formations in Colorado include the White River, Green River, and Morrison formations. The White River formation, noted for having some of the richest mammal fossil beds in the world, is in northeastern Colorado, and contains camels, elephants, mammoths, horses, hippos, and rhinoceroses. The Green River Formation, in northwest Colorado, includes fossils of frogs, beetles, scorpions, fish, insects, and trees. Western Colorado's Morrison Formation has yielded many dinosaur tracks and fossils. The Florissant Fossil Beds National Monument (Figure 3.1.3-4) is one of the richest insect and plant fossil deposits in the world, and includes more than 60,000 fossil specimens from an entire ecosystem that became buried in volcanic ash 34 MYA (Colorado Geological Survey, 2015k).

Colorado State Fossil
Adult and Young Stegosaurus

Source: (CPW, 2015i)

Cambrian Period marine fossils in Colorado include burrows, tracks, and trails of marine animals. Paleozoic Era marine fossils include brachiopods[56] and corals; from the Carboniferous Period, sharks, trilobites,[57] brachiopods, crinoids,[58] conifers, tree lycopods, and calamites are documented. Mesozoic Era fossils include large amphibians, phytosaurs, aetosaurs, and conifers. Jurassic Period fossils include large dinosaurs such as sauropods, and smaller dinosaurs including allosaurs, ceratosaurs, camptosaurs, and stegosaurs (Paleontology Portal, 2015). The stegosaurus is the state fossil of Colorado (Colorado Geological Survey, 2015l). Cretaceous Period fossils include dinosaur footprints, flowering plants, giant clams and fish, mosasaurs, plesiosaurs, ammonites, baculites, and dinoflagellates. Fossils from the early Cenozoic Era, such as crocodiles, turtles, and mammals such as bear dogs, giant pigs, rhinos, gomphotheres, and titanotheres have been recorded, along with stumps of giant trees. Fossils from the later Cenozoic Era (Quaternary Period) include mammals such as bison, horses, camels, mammoths, sloths, lions, cheetah, and bear (Paleontology Portal, 2015).

[56] 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)
[57] Trilobite: "Any member of Trilobita, an extinct class of marine arthropods. Trilobites are known from the Cambrian to the Permian. They had segmented, oval-shaped bodies and were the first animals to have complex eyes (similar to the compound eyes in modern insects)." (Smithsonian Institution, 2016)
[58] Crinoid: "The common name for any echinoderm of the class Crinoidea, including sea lilies, feather stars, etc. Crinoids are common fossils in the Paleozoic and persist to the present. Many species have stalks and radiating arms and feed on particles in the water column." Echinoderm: "The common name for members of the phylum Echinodermata. These organisms are characterized by bodies showing radial symmetry (usually in fives) and the presence of tube feet in most forms." (Smithsonian Institution, 2016)

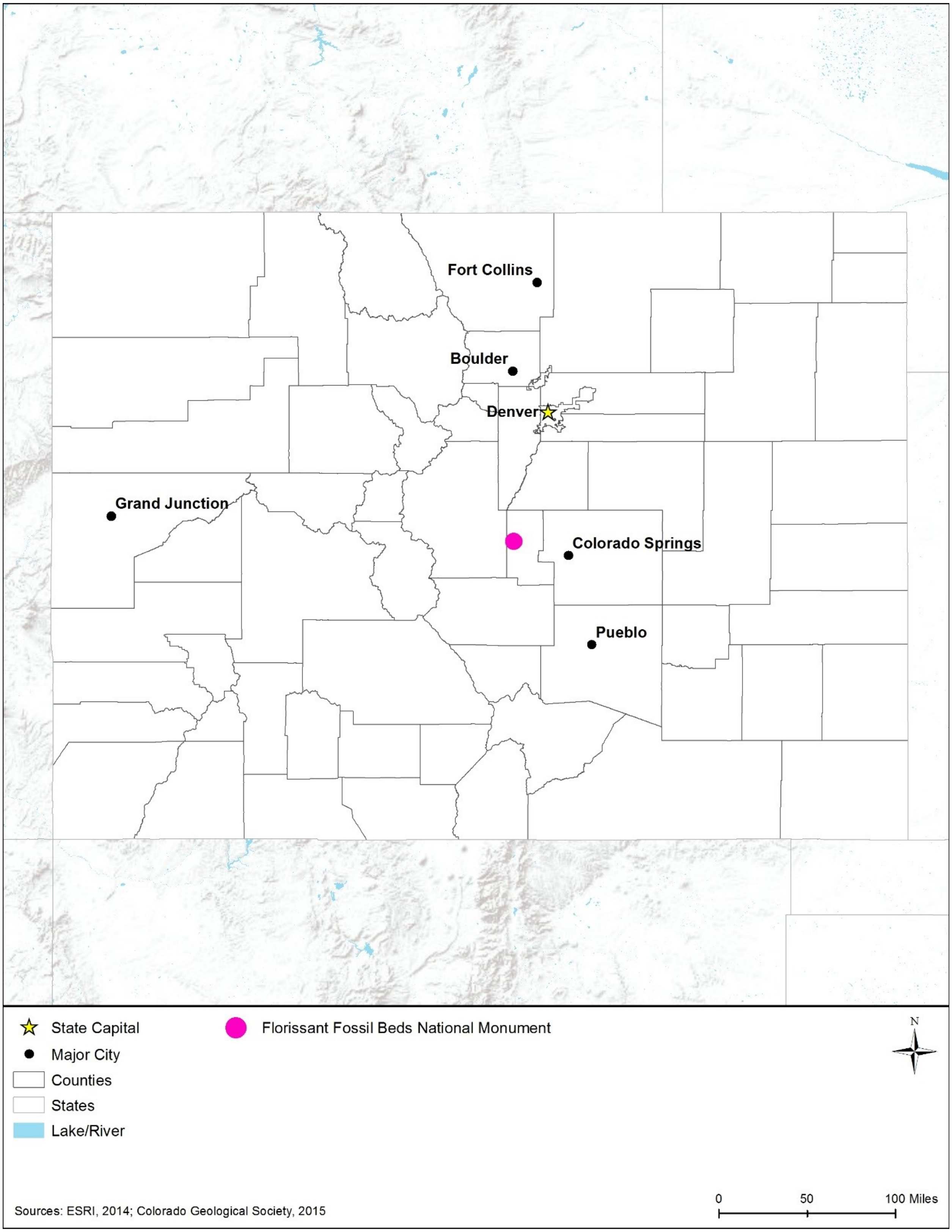

Figure 3.1.3-4: Florissant Fossil Beds National Monument

3.1.3.7. Fossil Fuel and Mineral Resources

Oil and Gas

In 2014, Colorado produced approximately 3 out of every 100 barrels of crude oil in the United States. The Wattenberg Field in northeast Colorado, Niobara Shale Formation in the northeastern portion of the state, and the Piceance Basin in western Colorado are among the state's most productive oil fields. In 2013, Colorado had 63 rotary rigs and the state produced 199.0 million barrels of crude oil in 2015, accounting for 3 percent of total nationwide production (EIA, 2014b). Colorado's Green River Formation contains some of the largest oil deposits in the world within its shale units. The Green River Formation may contain up to 1.8 trillion barrels of oil, though all of it may not be recoverable (Argonne National Laboratory, 2015).

Colorado is one of the largest producers of natural gas in the nation; Colorado has 11 of the 100 largest natural gas producing fields nationwide. Colorado produced more than 1.6 million cubic feet of natural gas in 2014. The San Juan, Denver-Julesberg, and Piceance Basins contain much of Colorado's accessible natural gas (EIA, 2014b).

Minerals

Colorado is one of the nation's leading producers of non-fuel mineral resources. As of 2015, Colorado's non-fuel mineral production was valued at $2.41B, ranking it 12th in the nation. Colorado accounted for about 3.09 percent of the U.S. total nonfuel mineral production value in 2015. Molybdenum concentrates, sand and gravel,[59] (construction), cement (portland), gold, and stone (crushed) were the principal minerals produced, in order of value, in 2015 (USGS, 2016b). In 2011, Colorado ranked first nationwide in molybdenum production, fourth nationwide in gold production, and eighth nationwide in gemstone production. Colorado is also a producer of bentonite, gypsum, dimension stone,[60] common clays and shale, sulfur, silver, and perlite are also produced and mined in the state (USGS, 2016b) (USGS, 2001).

Colorado has substantial coal production, including bituminous,[61] subbituminous,[62] and lignite[63] coals. In 2013, Colorado produced 24,236 thousand short tons of coal, accounting for a 2.5 percent of total nationwide production (EIA, 2015h). The Green River, Uinta, and San Juan basins, all of which are within the Colorado Plateaus Province, are major areas of coal production. "The coal deposits are concentrated in sedimentary basins isolated during the Late Cretaceous Laramide orogeny" (Kirschbaum, 2015).

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[59] Note: Construction sand and gravel are not included in the spatial data used as the basis for Figure 3.1.3-5.
[60] Dimension stone: "Natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size (width, length, and thickness) and shape." (USGS, 2016e)
[61] Bituminous Coal: "A dense coal, usually black, sometimes dark brown, often with well-defined bands of bright and dull material, used primarily as fuel in steam-electric power generation, with substantial quantities also used for heat and power applications in manufacturing and to make coke." (EIA, 2016c)
[62] Subbituminous Coal: "A coal whose properties range from those of lignite to those of bituminous coal and used primarily as fuel for steam-electric power generation." (EIA, 2016c)
[63] Lignite Coal: "The lowest rank of coal, often referred to as brown coal, used almost exclusively as fuel for steam-electric power generation." (EIA, 2016c)

3.1.3.8. Geologic Hazards

The three major geologic hazards of concern in Colorado are earthquakes, landslides, and land subsidence. The Dotsero Volcanic Center in central Colorado was active between 3,800 and 5,500 years ago and therefore do not present a hazard to the state (USGS, 2015c). The subsections below summarize current geologic hazards in Colorado.

Earthquakes

Between 1960 and 2011, there were six earthquakes of a magnitude 5.0 (on the Richter scale[64]) or greater in Colorado (Colorado Geological Survey, 2015m). 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.

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

Figure 3.1.3-5 depicts the seismic risk throughout Colorado; 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) with a 2 percent chance of being exceeded in a 50-year period. Units on the map are measured in terms of acceleration due to gravity (% g). Most pre-1965 buildings are likely to experience damage with exceedances of 10 percent g. Post-1985 buildings (in California) have experienced only minor damage with shaking of 60 percent g. (USGS, 2010)

Areas of greatest seismicity in Colorado are concentrated in the west and northwestern portions of the state (USGS, 2014c), though more than 700 minor to moderate earthquakes have been recorded throughout the state (Colorado Geological Survey, 2015c). The costliest measured earthquake in Colorado's history occurred in August 1967 (5.3 on the Richter scale). The epicenter of the earthquake was in Commerce City in northeast Denver (Colorado Geological Survey 2015c). Widespread damage (exceeding $1M in 1967 dollars and $7M in 2012 dollars), including “considerable cracked plaster and mortar, broken windows, damaged foundations and chimneys, and damage to household goods” was experienced throughout metropolitan Denver. Tremors were felt as far away as Sterling, Pueblo, and Laramie. (USGS, 2015d)

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

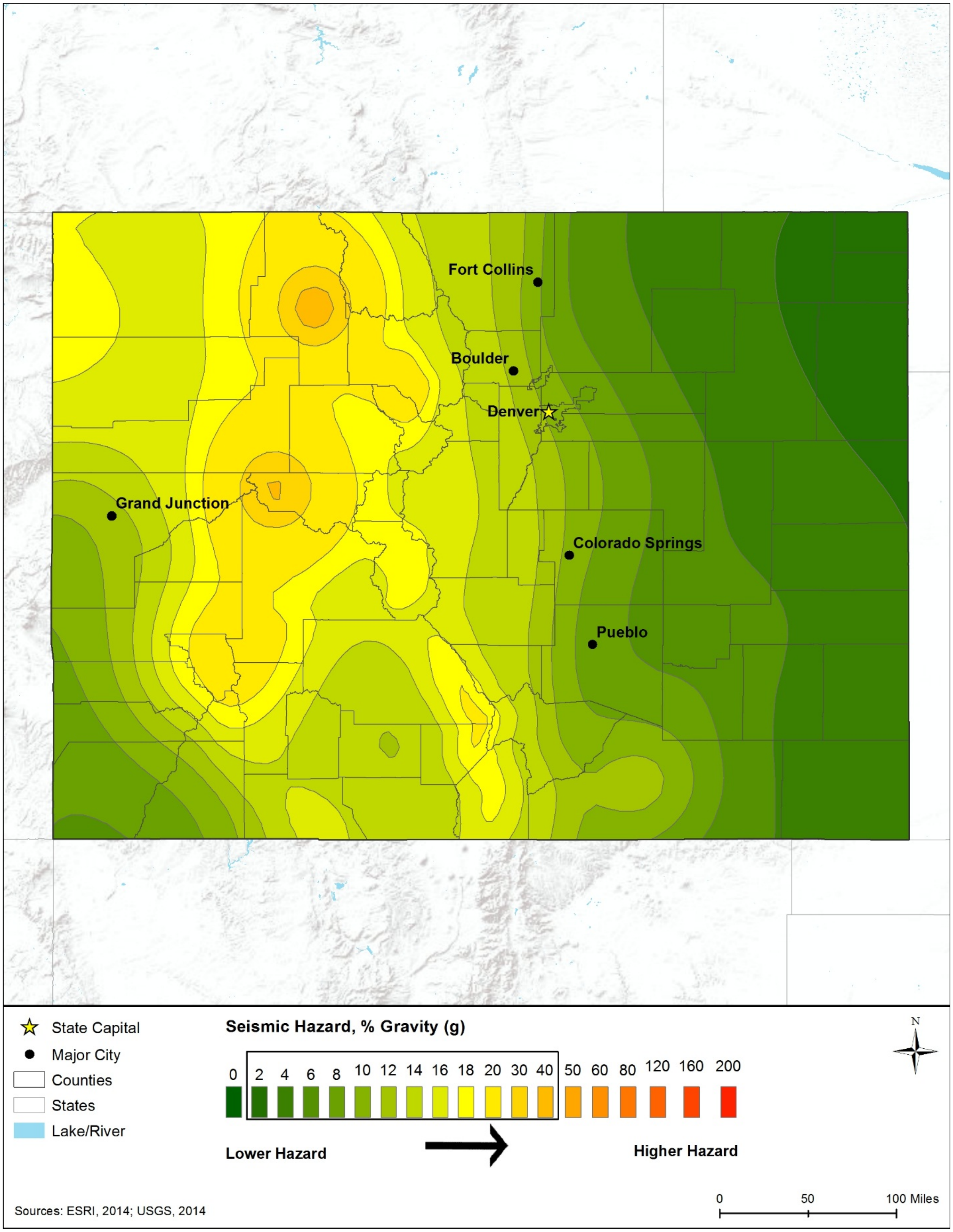

Figure 3.1.3-5: Colorado 2014 Seismic Hazard Map

Landslides

Landslides in Colorado are most common in the western half of Colorado throughout the Rocky Mountains (Highland, 2012). "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, 2003c). 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, 2003c)

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, 2003c)

Colorado's landslides are generally associated with areas with significant slope, which includes portions of Colorado within the Southern Rocky Mountain System. Anthropogenic[65] perturbances to the landscape or heavy precipitation events both increase the likelihood of landslide events in Colorado. In 2010, 14 landslides were documented in Colorado, including rockfalls that impacted travel on both an interstate highway and railway (Highland, 2012). During September 2013, significant precipitation events throughout Colorado resulted in widespread landslides throughout the northern Front Range. "Landslides and flooding [were] responsible for eight fatalities and caused extensive damage to buildings, highways, and infrastructure" (Godt, 2014). Figure 3.1.3-6 shows landslide incidence and susceptibility throughout Colorado.

[65] 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)

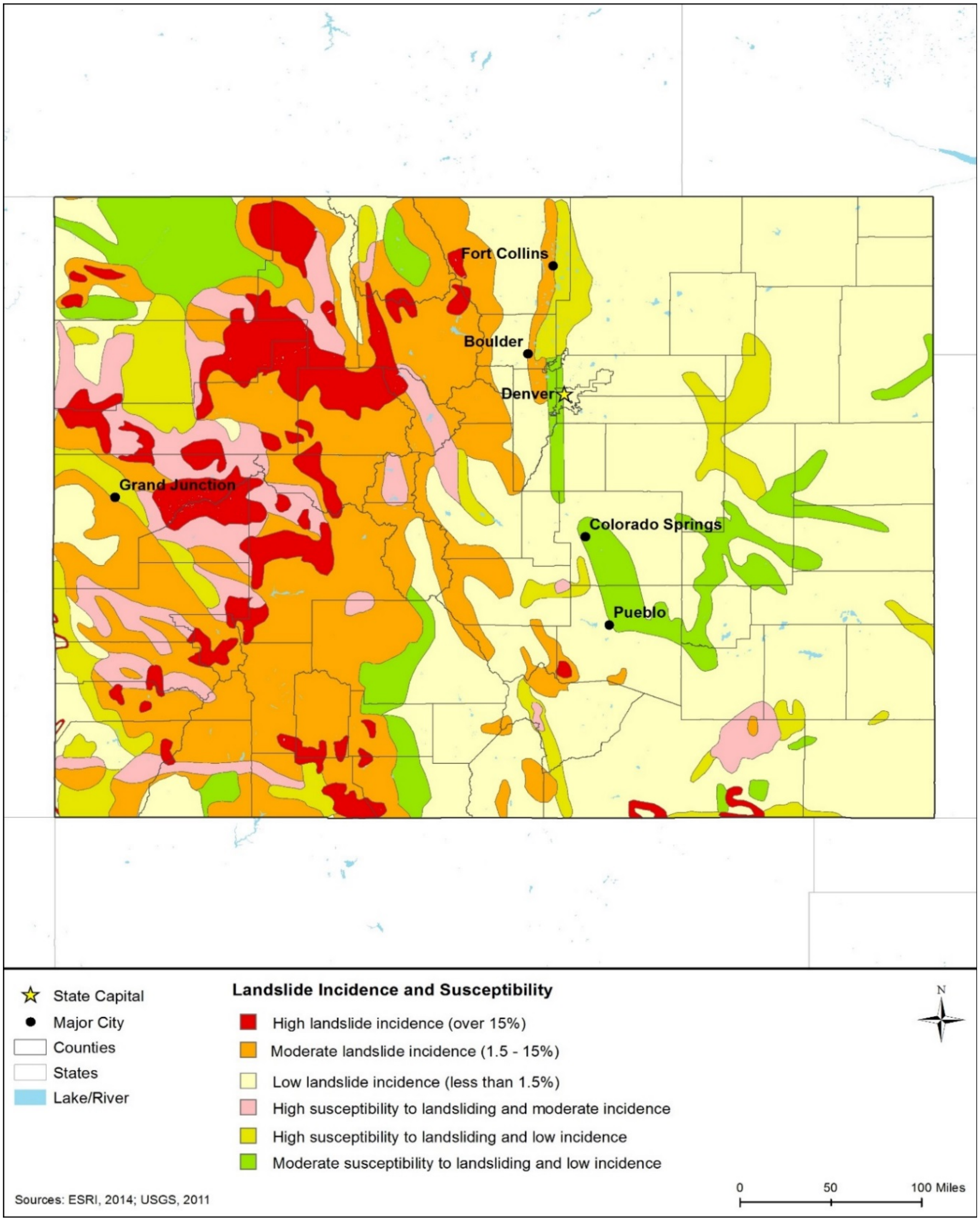

Figure 3.1.3-6: Colorado Landslide Incidence and Susceptibility Hazard Map[66]

[66] Susceptibility hazards not indicated in Figure 3.1.3-6 where same or lower than incidence. Susceptibility to landslides is defined as the probable degree of response of areal rocks and soils to natural or artificial cutting or loading of slopes, or to anomalously high precipitation. High, moderate, and low susceptibility are delimited by the same percentages used in classifying

Land Subsidence

Warped Sidewalk in Meeker, CO Attributed to Collapsible Soils

Source: (Colorado Geological Survey, 2015b)

Land subsidence is a "gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials." Land subsidence in Colorado is most often attributed to collapsible soils, mine subsidence, and karst[67] topography (Colorado Geological Survey, 2015a). The main triggers of land subsidence can be aquifer compaction, drainage of organic soils, mining, sinkholes, and thawing permafrost. More than 80 percent of subsidence in the United States is due to over-withdrawal of groundwater. In many aquifers, which are subsurface soil layers through which groundwater moves, water is pumped from pore spaces between sand and gravel grains. If an aquifer is confined by layers of silt or clay, which do not transport groundwater, the lowered water pressure in the sand and gravel causes slow drainage of water from the clay and silt beds. The reduced water pressure compromises support for the clay and silt beds, causing them to collapse on one another. The effects of this compression are seen in the permanent lowering of the land surface elevation (USGS, 2000).

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

Subsidence due to collapsible soils generally occurs when vulnerable soil types become oversaturated with water; these types of soils are common in dry climates in the western United States. Sediments in collapsible soils are typically loosely packed together; while each individual grain sticks to one another during dry conditions, the arrival of water to these soils results in the dissolution of binding agents and the grains reconfigure into a denser orientation. "This relatively rapid densification of the soil causes a net volume loss of the soil deposit, which is manifested at the ground surface as subsidence or settlement" (Colorado Geological Survey, 2015b). Collapsible soils are most common due to the compaction of sediments within alluvial

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

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

fans.[68] The Roaring Fork Valley near Glenwood Springs is particularly susceptible to subsidence due to collapsible soils. Structural damage has been observed to both concrete building foundations and the buildings themselves due to subsidence of as little as 4 inches (Hazardous Soils in Colorado, 2012). In the nearby town of Meeker, land subsidence due to collapsible soils has been observed on the order of 4 feet (Colorado Geological Survey, 2015b).

While Colorado's mining industry has been reduced in recent years, the aftermath of decades of gold, silver, and coal mining continues to be felt throughout parts of the state in the form of mine subsidence. Both ore and coal mines have been susceptible to land subsidence in Colorado, with the risk of subsidence a function of the "depth of the mine workings,[69] the geometry of the mine, how much coal was extracted, the overlying geology, and groundwater fluctuations." More than 1,700 coal mines have been identified throughout the state. Areas of Colorado at the greatest risk to mine subsidence include "much of the Front Range, including El Paso, western Jefferson and southern Boulder and Weld Counties" (Colorado Geological Survey, 2015e). When overlying lands have been developed in areas where subsidence occurs, damage to infrastructure (e.g., buildings, utilities, roadways) can result (Survey, 2012b).

Natural land subsidence is also a problem in parts of Colorado in the form of karst topography. Karst topography in Colorado typically occurs in areas that are underlain by evaporate rocks,[70] such as gypsum. Land subsidence due to evaporate dissolution has been observed on the order of hundreds to thousands of feet, particularly in the areas of the Roaring Fork River and Eagle Valleys (Colorado Geological Survey, 2015f). Figure 3.1.3-7 displays the areas of Colorado that are susceptible to land subsidence due to karst topography.

[68] Alluvial Fan: "A fan-shaped pile of sediment that forms where a rapidly flowing mountain stream enters a relatively flat valley. As water slows down, it deposits sediment (alluvium) that gradually builds a fan." (USGS, 2015h)
[69] Landscapes are more susceptible to land subsidence in shallower mines. (Colorado Geological Survey, 2012b)
[70] Evaporite Rocks: "A nonclastic sedimentary rock composed primarily of minerals produced from a saline solution as a result of extensive or total evaporation of the solvent. This category is also used for gypsum." (USGS, 2014i)

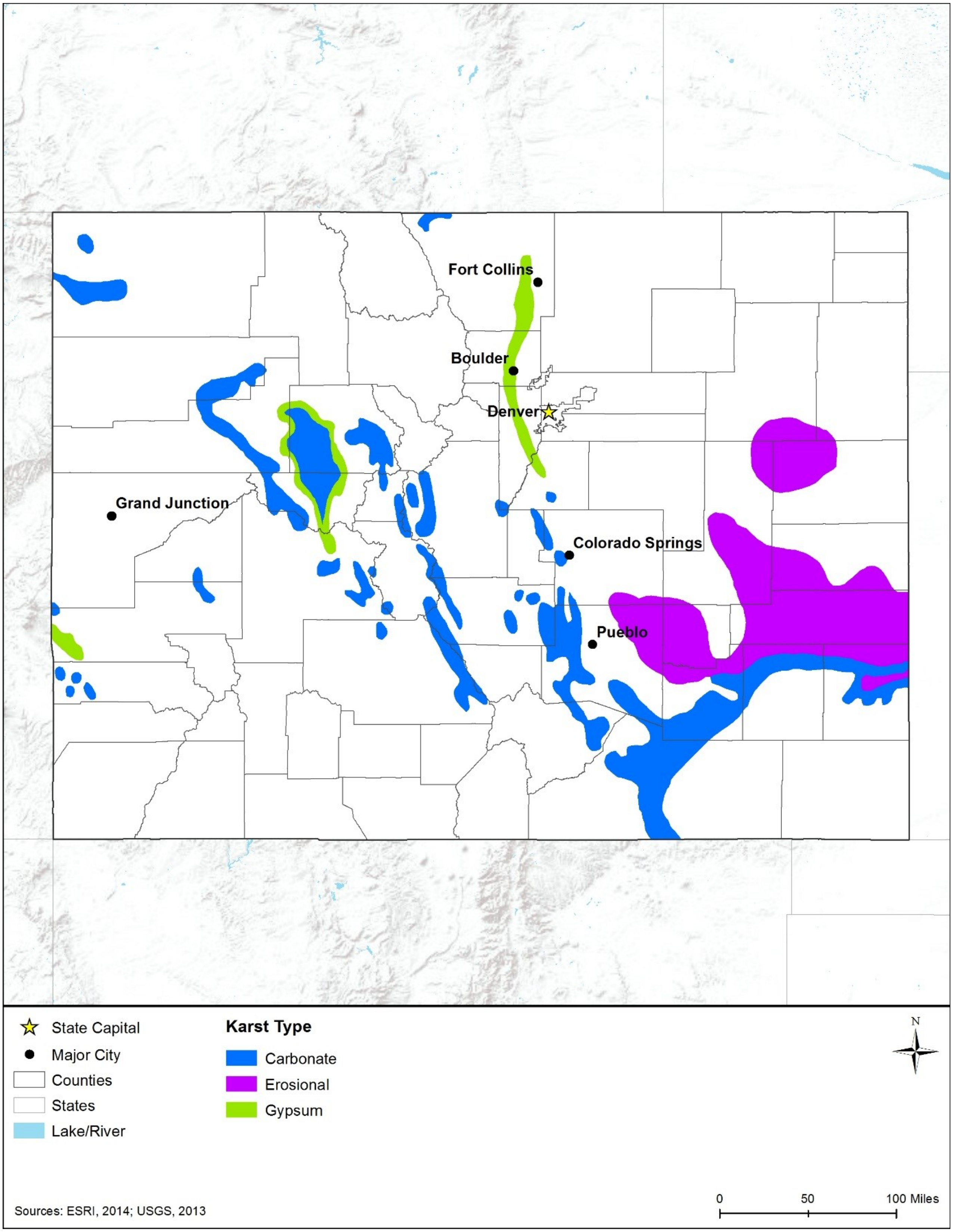

Figure 3.1.3-7: Colorado Karst Topography

3.1.4. Water Resources

3.1.4.1. Definition of the Resource

Water resources are defined as all surface water bodies and groundwater systems including streams, rivers, lakes, floodplains, aquifers, and other aquatic habitats (wetlands are discussed separately in Section 3.1.5). These resources can be grouped into watersheds which are defined as areas of land whose flowing water resources (including runoff from rainfall) drain to a common outlet such as a river or ocean. The value and use of water resources are influenced by the quantity and quality of water available for use and the demand for available water. Water resources are used for drinking, irrigation, industry, recreation, and as habitat for wildlife. Some water resources that are particularly pristine, sensitive, or of great economic value enjoy special protections under federal and state laws. An adequate supply of water is essential for human health, economic wellbeing, and ecological health. (USGS, 2014d)

3.1.4.2. Specific Regulatory Considerations

Federal laws relevant to protecting the quality and use of water resources are summarized in Appendix C, Environmental Laws and Regulations. Table 3.1.4-1 summarizes the major Colorado laws and permitting requirements relevant to the state's water resources.

Table 3.1.4-1: Relevant Colorado Water Laws and Regulations

State Law/Regulation	Regulatory Agency	Permit Requirements
Prior Appropriation Law	Colorado Division of Water Resources	Defines Colorado water permit requirements.
Colorado Discharge Permit System Regulations	Colorado Department of Public Health and Environment (CDPHE)	Construction activities that disturb one or more acre of soil over the duration of a project.
Clean Water Act (CWA) Section 401 permit	CDPHE	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 CDPHE indicating that the proposed activity will not violate water quality standards.
CWA Section 404 permit, Nationwide Permit, Colorado Regional Conditions	U.S. Army Corps of Engineers (USACE), Sacramento District	Critical Resource Waters (Animas, Florida, Big Thompson, Blue, Colorado, Dolores, Cache la Poudre, Eagle, Gunnison, Laramie, Los Pinos, Mancos, North Fork Gunnison, Piedra, Rio Grande, San Juan, San Miguel, South Platter, Uncompahgre, White, and Yampa Rivers, and Bear, Boulder, Hermosa, Fountain, Clear, Northwater, Trapper, Battlement, Rapid, Abrams Medano Sand, and St. Vrain Creeks and their tributaries) are regulated.

3.1.4.3. Environmental Setting: Surface Water

Surface water resources are natural and engineered lakes, ponds, rivers, and streams. According to the CDPHE, Colorado has approximately 105,000 miles of rivers and streams and 250,000 acres of lakes and reservoirs. Most of these waters originate at high elevations in pristine alpine conditions before flowing downstream and leaving the state. (CDPHE 2011)

Watersheds

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). Colorado's waters (lakes, rivers, and streams) are divided into eight major watersheds, or drainage basins (or watershed). The South Platte River Basin is expected to experience the greatest water demand by 2050, followed by the Arkansas River Basin. The South Platte watershed includes the cities of Boulder, Fort Collins, Longmont, Greeley, and Denver. The Denver metro population accounts for approximately half of the entire state's population, and is expected to rise from 2.6 million residents in 2010 to nearly 4.1 million by 2050 (State of Colorado, 2015a). The Arkansas River Basin includes the cities of Colorado Springs and Pueblo, and has seen an increased change from agricultural use to municipal and industrial (M&I) water uses (CWCB, 2015). Colorado Appendix A, Table A-1, provides detailed information on the state's major watersheds, as defined by the Colorado Water Conservation Board (CWCB). For information and additional maps about each watershed's location, size, and water quality, see cwcb.state.co.us/water-management/basin-roundtables/Pages/main.aspx.

Freshwater

As shown in Figure 3.1.4-1, major rivers in Colorado include the South Platte, Arkansas, and Colorado Rivers. The South Platte River begins in the mountains west of Colorado Springs, and flows approximately 1,000 miles to its mouth in eastern Nebraska. The Arkansas River starts in Lake County, and flows approximately 1,500 miles to its mouth in Arkansas. The Colorado River begins in Grand County, and flows approximately 1,500 miles to its mouth in Mexico. (USGS, 1990)

Blue Mesa Reservoir is the state's largest lake. It was constructed as part of the Bureau of Reclamation's Colorado River Storage Project to store water in the upper Colorado River basin, control flooding, develop recreation, provide fish and wildlife habitat, and provide energy needs in the upper basin. The Blue Mesa Dam was built on the Gunnison River, approximately 30 miles below the town of Gunnison. The Blue Mesa reservoir has a storage capacity of over 940,000 acre-feet, and at maximum surface water elevation, encompasses nearly 9,200 acres. (Bureau of Reclamation, 2010)

3.1.4.4. Sensitive or Protected Waterbodies

Wild and Scenic Rivers

Portions of the Cache la Poudre River in northern Colorado are federally designated National Wild and Scenic Rivers (Figure 3.1.4-1) (see Appendix C, Environmental Laws and Regulations, for more information on the Wild and Scenic Rivers Act). Designated sections of the Cache la Poudre River include 30 miles classified as wild and 46 miles as recreational. (NWSRS, 2015) More information on Wild and Scenic Rivers is presented in Section 3.1.8, Visual Resources.

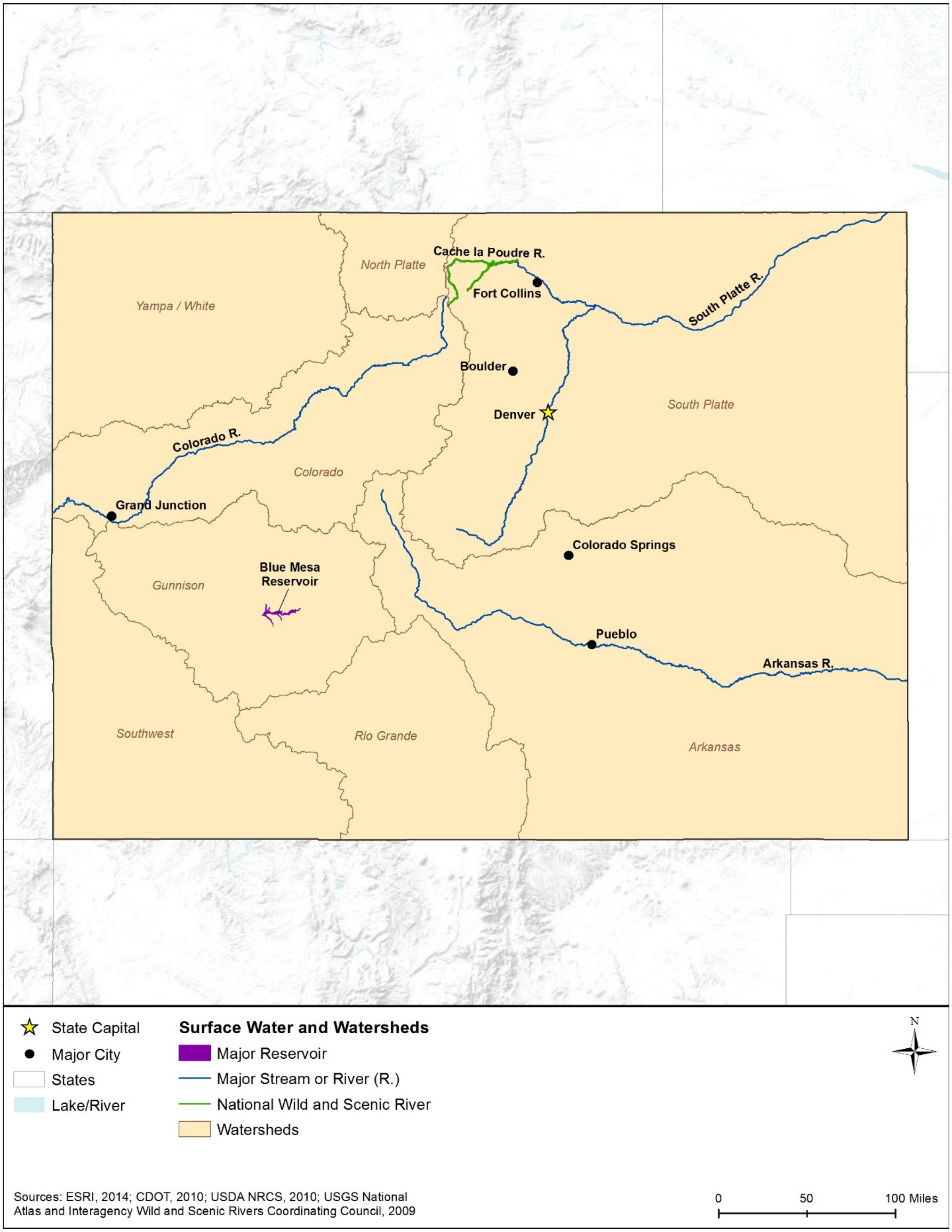

Figure 3.1.4-1: Major Colorado Watersheds, defined by CWCB, and Surface Waterbodies

3.1.4.5. Impaired Waterbodies

Several elements, including temperature, dissolved oxygen, suspended sediment, nutrients, metals, oils, observations of aquatic wildlife communities, and sampling of fish tissue, are used to evaluate water quality. Under Section 303(d) of the CWA, states are required to assess water quality and report a listing of impaired waters,[71] the causes of impairment, and probable sources. Table 3.1.4-2 summarizes the water quality of Colorado's assessed major waterbodies by category, percent impaired, designated use,[72] cause, and probable sources.

Figure 3.1.4-2 shows the Section 303(d) waters in Colorado as of 2014.

As shown in Table 3.1.4-2, various sources affect Colorado's waterbodies, causing impairments. Nearly half of Colorado's lakes, reservoirs, and ponds are impaired. Designated uses of the impaired lakes include Agriculture, Aquatic Life Cold Water-Class 1 and Class 2, Aquatic Life Warm Water-Class 1 and Class 2, Domestic Water Source, Recreation Primary and Secondary Contact. (USEPA, 2015e)

Table 3.1.4-2: Section 303(d) Impaired Waters of Colorado, 2014

Water Type[a]	Amount of Waters Assessed[b] (Percent)	Amount Impaired (Percent)	Designated Uses of Impaired Waters	Top Causes of Impairment	Top Probable Sources for Impairment
Rivers and Streams	66%	17%	Agriculture, Aquatic Life Cold Water-Class 1 and Class 2, Aquatic Life Warm Water-Class 1 and Class 2, Domestic Water Source, Recreation Primary and Secondary Contact	Metals (including selenium, iron, copper, and zinc), pathogens,[c] and temperature	Unknown sources, agriculture, impacts from abandoned mine lands
Lakes, Reservoirs, and Ponds	93%	46%	Agriculture, Aquatic Life Cold Water-Class 1 and Class 2, Aquatic Life Warm Water-Class 1 and Class 2, Domestic Water Source, Recreation Primary and Secondary Contact	Metals (including selenium, copper, and arsenic), mercury, Organic Enrichment/ Oxygen Depletion, pH/Acidity/Caustic Conditions, and ammonia	Unknown sources, impacts from abandoned mine lands, natural sources

Source: (USEPA, 2015e)

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

[71] Impaired waters: "Waterways that do not meet state water quality standards. Under the CWA, Section 303(d), states, territories, and authorized tribes are required to develop prioritized lists of impaired waters." (USEPA, 2015o)
[72] 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, 2015o)

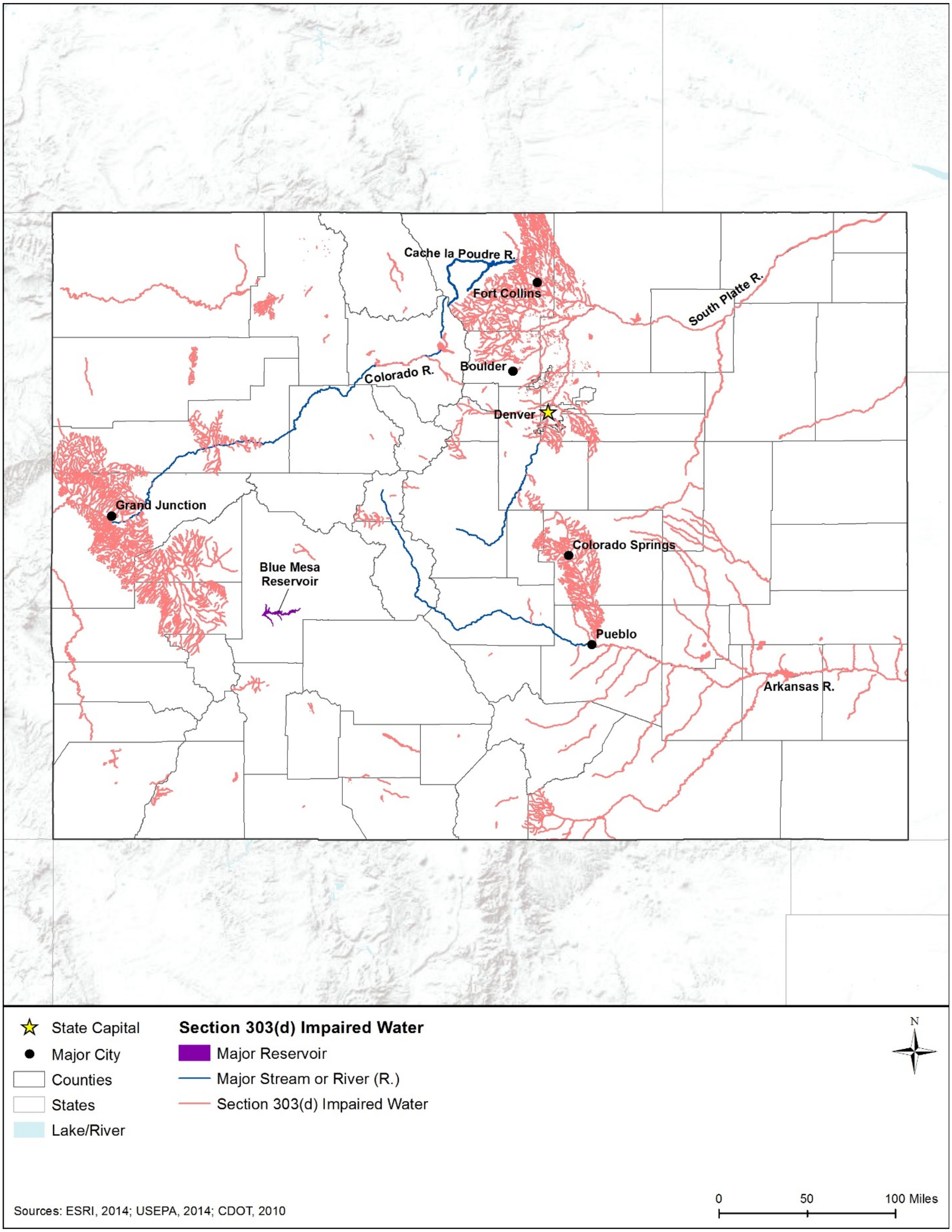

Figure 3.1.4-2: Section 303(d) Impaired Waters of Colorado, 2014

The most common pollutants associated with impaired waters in Colorado are heavy metals (cadmium, copper, lead, mercury, selenium, and zinc) and other metals including iron, manganese, and sulfate. Arsenic is also a common pollutant, as are radionuclides, including uranium. The pollutants with the greatest associated impaired segments are selenium, *E. coli,* cadmium, and copper. Lake impairments are typically associated with dissolved oxygen and mercury, and occur across the state. The typical causes for these impairments include upstream sources and runoff from roads, mining activities (including abandoned mined lands), groundwater, and natural processes. For more information on Colorado's water quality, see the Statewide Water Quality Management Plan at https://www.colorado.gov/pacific/cdphe/statewide-water-quality-management-plan (CDPHE, 2011)

3.1.4.6. Floodplains

The Federal Emergency Management Agency (FEMA) defines a floodplain or flood-prone area as "any land area susceptible to being inundated by water from any source" (44 Code of Federal Regulations [CFR] 59.1) (FEMA, 2000). 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 is one primary type of floodplain in Colorado. Riverine and lake floodplains occur along rivers, streams, or lakes where overbank flooding may occur, inundating adjacent land areas. In mountainous areas, such as Colorado's Southern Rocky Mountains, floodwaters can build and recede quickly, with fast moving and deep water. Flooding in these areas can cause greater damage than typical riverine flooding due to the high velocity of water flow, the amount of debris carried, and the broad area affected by floodwaters. Whereas, flatter floodplains may remain inundated for days or weeks, covered by slow-moving and shallow water. (FEMA, 2014b)

Flooding is the leading cause for disaster declaration by the President in the U.S. and results in significant damage throughout the state annually (NOAA, 2015c). There are several causes of flooding in Colorado, often resulting in loss of life and damage to property, infrastructure, agriculture, and the environment. Snow runoff and precipitation events, combined with the mountain and foothill environment of Colorado, results in an increased likelihood for flash floods. Although some areas, such as floodplains, are more prone to flooding than others, no area in the state is exempt from flood hazards. All 64 Colorado counties have been identified as flood prone, and on average, Colorado experiences a major flood every five years. Major flood events include the 1965 South Platte River flood in Denver, where damages were approximately $2.7 billion (2010 dollars), and more recently the 2013 floods along the Front Range that resulted in approximately $3 billion in widespread damages. The Big Thompson flood in 1976 was the states' deadliest, with 145 fatalities. (DSHEM, Colorado Natural Hazards Mitigation Plan)

2013 Colorado Floods

Source: (NOAA, 2013)

Record heat, followed by subtropical moisture system moving over the area, resulted in very heavy prolonged rainfall along the front range of the Rocky Mountains from September 11-18, 2013. This event caused historic flooding, and was a one in 1,000-year flood event for some localities. (NOAA, 2015a) This storm resulted in 10 fatalities, 18 counties declared as disaster areas, and nearly $3 billion in damages (CWCB, 2014).

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 250 communities in Colorado through the National Flood Insurance Program (NFIP) (FEMA, 2014c). Established to reduce the economic and social cost of flood damage by subsidizing insurance payments, the NFIP encourages communities "to adopt and enforce floodplain management regulations and to implement broader floodplain management programs" and allows property owners in participating communities to purchase insurance protection against losses from flooding by reducing flood insurance premiums in exchange (FEMA, 2015). As an incentive, communities can voluntarily participate in the NFIP Community Rating System, 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, Colorado had 52 communities participating in the Community Rating System (FEMA, 2014d).[73]

[73] A list of the 52 Community Rating System, dated May 1, 2014, can be found at http://www.fema.gov/media-library-data/13988788921025cbcaa727a635327277d834491210fec/CRS_Communites_May_1_2014.pdf) and additional program information is available from FEMA's NFIP CRS website (www.fema.gov/national-flood-insurance-program-community-rating-system).

3.1.4.7. Groundwater

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

Colorado's principal aquifers consist of alluvial aquifers, consolidated sedimentary rock aquifers, and unconsolidated sedimentary rock aquifers. The groundwater in Colorado is generally suitable for most uses, although some locations have experienced inorganic and organic chemical groundwater contamination from urbanization, mining activities, and waste disposal. Pesticides have also been detected from agricultural and forestland applications, and some increased dissolved mineral concentrations have been detected in agricultural uses from evapotranspiration[74] and water reuse. (Moody, Carr, Chase, & Paulson, 1986)

Surface water provides the majority of the state's water supply; only about 18 percent of groundwater is used for Colorado's water supply needs (Colorado Geological Survey, 2015n). Of this, approximately 96 percent of groundwater is used for irrigation, 2 percent used for public water supply, 1 percent for rural domestic supply, and 1 percent for industrial use and livestock (Moody, Carr, Chase, & Paulson, 1986).

Table 3.1.4-3 provides details on aquifer characteristics in the state; Figure 3.1.4-3 shows Colorado's principal aquifers. There are no sole source aquifers (SSAs) within Colorado (USEPA, 2015b).

[74] Evapotranspiration: The total amount of water used (transpired) by vegetation and lost by evaporation (USEPA, 2015p).

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

Aquifer Type and Name	Location in State	Groundwater Quality
Colorado Plateaus Aquifers Alluvial Aquifers	Western Colorado	Groundwater quantity and quality is extremely variable; however, the water quality is generally suitable for most domestic and agricultural uses.
Denver Basin aquifer system Consolidated Sedimentary Rock Aquifer	Central Colorado, including Denver and Colorado Springs area	Ranges from soft to hard. Iron and sulfate have been detected, and in some instances reducing conditions in the aquifer have resulted in sulfate minerals and natural reducing to hydrogen sulfide and methane gases, causing a putrid odor and water to effervesce, which may be unacceptable for certain uses.
High Plains Aquifer Unconsolidated Sedimentary Rock Aquifer	Eastern Colorado	Dissolved solids and sulfate concentrations are higher in the southern area of the aquifer, as are fluoride concentrations. The water is typically very hard.
Rio Grande Aquifer System Unconsolidated Sedimentary Rock Aquifer	South-central Colorado	Water quality in the confined areas of the aquifer is high, while water quality in the unconfined portions range from very good to poor, particularly near San Luis Lakes northeast of Alamosa. Total dissolved concentrations are low to moderate, except for the area around the San Luis Lakes where salinities can be very high.

Source: (Moody, Carr, Chase, & Paulson, 1986) (Colorado Geological Survey, 2015n)

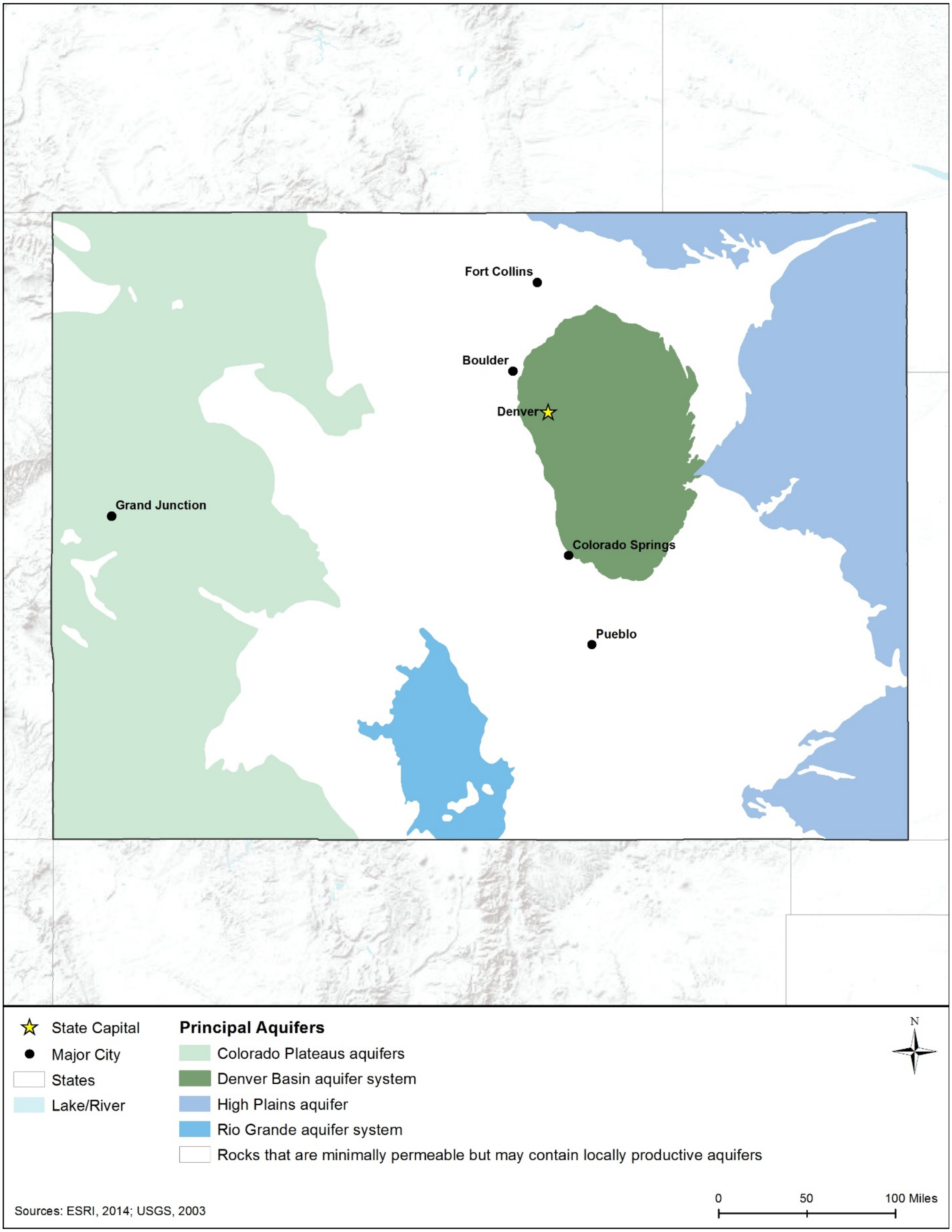

Figure 3.1.4-3: Principal Aquifers of Colorado

3.1.5. Wetlands

3.1.5.1. Definition of the Resource

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

The USEPA estimates that "more than one-third of the United States' threatened and endangered species live only in wetlands, and nearly half of such species use wetlands at some point in their lives" (USEPA, 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.

3.1.5.2. Specific Regulatory Considerations

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

Table 3.1.5-1: Relevant Colorado Wetlands Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CWA Section 404 permit, Colorado regional conditions	USACE, Sacramento District	The NWP program does not authorize certain activities in Critical Resource Waters, which includes: wetlands that are tributaries to the Animas, North Platte, Roaring Fork, Cache la Poudre, Florida, Big Thompson, Blue, Colorado, Dolores, Eagle, Gunnison, Laramie, North Platte, Roaring Fork, Los Pinos, North Fork Gunnison, Piedra, Rio Grande, San Juan, San Miguel, South Platter, Uncompahgre, White, and Yampa Rivers, and Bear, Clear, Sand, Medano, Northwater, Trapper, Abrams, Battlement, Rapid, Boulder, and St. Vrain Creeks, Smith Fork.
Colorado Discharge Permit System Regulations	Colorado Department of Public Health and Environment (CDPHE)	Stormwater discharges from non-extractive industrial activities including land transportation, transportation equipment, and air transportation facilities.
		Construction activities that disturb one or more acre of soil over the duration of a project.
CWA Section 401 permit	CDPHE	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 CDPHE indicating that the proposed activity will not violate water quality standards.

3.1.5.3. Wetland Types and Functions

The U.S. Fish and Wildlife Service's (USFWS) National Wetlands Inventory (NWI) mapping adopted a national Wetlands Classification Standard that classifies wetlands according to shared environmental factors, such as vegetation, soils, and hydrology, as defined in Cowardin et al.

(1979). The WCS includes five major wetland systems: Marine, Estuarine, Riverine, Lacustrine, and Palustrine (as detailed in Table 3.1.5-2). The first four of these include both wetlands and deepwater habitats but the Palustrine includes only wetland habitats (USFWS, 2015a).

- The Marine System consists of open ocean, continental shelf, including beaches, rocky shores, lagoons, and shallow coral reefs. Normal marine salinity (saltiness) to hypersaline (more than 30 percent salty) water chemistry; minimal influence from rivers or estuaries. Where wave energy is low, mangroves, or mudflats may be present.
- "The Estuarine System consists of deepwater tidal habitats and adjacent tidal habitats that are usually semi enclosed by land but have open, partly obstructed, or sporadic access to the open ocean and the ocean water is at least occasionally diluted by freshwater runoff from the land."
- "Riverine System includes all wetlands and deepwater habitats contained within a channel with two exceptions (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 ppt."
- Lacustrine System includes inland water bodies that are situated in topographic depressions, lack emergent trees and shrubs, have less than 30 percent vegetation cover, and occupy greater than 20 acres. Includes lakes, larger ponds, sloughs, lochs, bayous, etc.
- "Palustrine includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent." The system is characterized based on the type and duration of flooding, water chemistry, vegetation, or substrate characteristics (soil types) (Cowardin, Carter, Golet, & LaRoe, 1979) (FGDC, 2013).

Three of these systems—Riverine, Lacustrine, and Palustrine—are present in Colorado, as detailed in Table 3.1.5-2. In Colorado, the main type of wetland is palustrine (freshwater) wetlands found across the state, from the eastern plains to the alpine environment of the Rocky Mountains. Table 3.1.5-2 uses 2014 NWI data to characterize and map Colorado wetlands on a broad-scale. The data is not intended for site-specific analyses and is not a substitute for field-level wetland surveys, delineations, or jurisdictional determinations, which may be conducted, as appropriate, at the site-specific level once those locations are known. As shown in Figure 3.1.5-1, palustrine wetlands are found throughout the state, with large areas occurring in the central Rocky Mountains and the northeastern plains, while riverine are found throughout the state. Lacustrine wetlands are not common in the state, and thus are not discussed in significant detail. The map codes and colorings in Table 3.1.5-2 correspond to the wetland types in the figures.[75]

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

Table 3.1.5-2: Colorado Wetland Types, Descriptions, Location, and Amount, 2014

Wetland Type	Map Code and Color	Description[a]	Occurrence	Amount (acres)[b]
Palustrine forested wetland	PFO	PFO wetlands contain woody vegetation that are at least 20 feet tall. Floodplain forests, hardwood swamps, and silver maple-ash swamps are examples of PFO wetlands.	Central Rocky Mountains and northeastern plains	266,576
Palustrine scrub-shrub wetland	PSS	Woody vegetation less than 20 feet tall dominates PSS wetlands. Thickets and shrub swamps are examples of PSS wetlands.		
Palustrine emergent wetlands	PEM	Palustrine emergent wetlands have erect, rooted, green-stemmed, annual, water-loving plants, excluding mosses and lichens, present for most of the growing season in most years. PEM wetlands include freshwater marshes, wet meadows, fens,[c] prairie potholes, and sloughs.[d]		751,166
Palustrine unconsolidated bottom	PUB	PUB and PAB wetlands are commonly known as freshwater ponds, and includes all wetlands with at least 25 percent cover of particles smaller than stones and a vegetative cover less than 30 percent.	Throughout the state	97,030
Palustrine aquatic bed	PAB	PAB wetlands include wetlands vegetated by plants growing mainly on or below the water surface line.		
Other Palustrine wetland	Misc. Types	Farmed wetland, saline seep[e], and other miscellaneous wetlands are included in this group.	Throughout the state	10,954
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	80,863
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.	Uncommon, throughout the state	21,251
			TOTAL	**1,227,840**

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

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

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

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

[d] Slough: "swamp or shallow lake system, usually a backwater to a larger body of water." (NOAA, 2014)

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

Colorado has lost about 50 percent of its wetlands since European settlement, dwindling from approximately two million acres, to one million acres of wetlands today. Wetlands in Colorado comprise less than two percent of total surface area in the state, but nearly 75 percent of all species benefit from the habitat they provide. Current threats to wetlands in Colorado include agricultural use and grazing management, invasive plants, residential development, energy development and mining activities, transportation development, timber harvest, hydrologic alterations, and climate change. (CDOW, 2011) (CPW, 2015a)

Palustrine Wetlands

In Colorado, palustrine wetlands include the majority of vegetated freshwater wetlands, and include wet meadows, marshes, mineral or alkaline flats, and playas, and peatlands (Culver & Lemly, 2013).

Image of Wet Meadow

Source: (Culver & Lemly, 2013)

The most common type of palustrine emergent wetland (PEM) in Colorado are wet meadows. They are typically found in or next to irrigated areas on the plains, as well as around glacial lakes in the alpine and subalpine zones, fed by melting snow. Wet meadows provide habitat for birds, insects, and amphibians.

- Found across the state, PEM marshes are located anywhere deep water has accumulated for a long time, including the plains and the high mountains, and have emergent vegetation. Marshes are also located in the Great Sand Dunes National Park and Preserve, where the water table is at surface level. Marshes in Colorado provide important habitat for both shorebirds and waterfowl, particularly in the San Luis Valley.
- Mineral or alkaline flats are found on the Eastern slope of the Rockies, intermountain valleys, and in the San Luis Valley. These wetlands are flooded periodically, but are distinguished from playas by their clay texture and accumulation of salts from evaporation of high water tables. The plants found in these wetlands are salt loving and include greasewood *(Sarobatus vermiculatus),* alkali grasses *(Zygadenus elegans),* red glasswort *(Salicornia rubra),* and sea milkwort *(Glaux maritima).* These wetlands also provide habitat for shorebirds.
- Playas are fed by rainfall and surface runoff, and are found in the eastern plains. They provide surface water for ranching and agricultural communities, and provide habitat for wildlife and birds. Plants found in playa wetlands are usually annuals, such as ragweeds *(Ambrosia psilostachya),* goosefoots *(Chenopodiaceae sp.),* spikerushes *(Annona reticulate),* and bulrushes *(Cyperaceae sp.).*

Riverine Wetlands

Riparian wetlands in Colorado are found along rivers, recognized by streambank vegetation and bottomland floodplain. Dominant vegetation includes woody plants such as thin-leawf alders

(Alnus incana sp. *tenuifolia),* birch *(Betula* sp.*),* cottonwood trees *(Populus spp.),* and willows *(Salix spp.).* These wetlands also provide important habitat for fish, birds, and other wildlife, including declining species such as the greater sage grouse *(Centrocercus spp.)* and southwestern willow flycatcher (*Empidonax trailii extimus*) (Culver & Lemly, 2013).

3.1.5.4. Wetlands of Special Concern or Value in Colorado

Fens

The most common types of peatland in Colorado are fens. Fens are found in Colorado's mountainous areas, and are common between elevations of 8,000 and 12,000 feet, particularly in areas where groundwater is at the surface. These permanently saturated wetlands accumulate peat at a rate of 20 centimeters per 1,000 years. Although fens are common in the state, they are extremely fragile and if destroyed, cannot be replaced in our lifetime. Fens also provide habitat for rare animal and plant species, store significant amounts of soil carbon, and regulate local hydrology. The USFWS has designated them a Resource Category 1, meaning every reasonable effort must be made to avoid impacts to this habitat. In addition, the U.S. Forest Service (USFS) in the Rocky Mountain Region issued a statement in 2002 that fens are irreplaceable, and impacts must be avoided on National Forest Lands (Culver & Lemly, 2013) (CNHP, 2016).

Wetlands Associated with Critical Resource Waters

Wetlands that are tributaries to, or adjacent to, Colorado's Critical Resource Waters require additional permitting or notification under the state’s regional conditions to the USACE NWP permit. These waters include: the Animas, North Platte, Roaring Fork, Cache la Poudre, Florida, Big Thompson, Blue, Colorado, Dolores, Eagle, Gunnison, Laramie, Los Pinos, North Fork Gunnison, Piedra, Rio Grande, San Juan, San Miguel, South Platte, Uncompahgre, White, Yampa, Bear, Clear, Sand, Medano, Northwater, Trapper, Abrams, Battlement, Rapid, Boulder, and Smith Fork Rivers; and the St. Vrain Creek. (USACE, 2015)

Other important wetland sites in Colorado include:

- State Wildlife Areas are designated for the benefit of wildlife-related public recreation. There are approximately 350 parcels in the state (CPW, 2015m). To learn more about state Wildlife Areas, see cpw.state.co.us/placestogo/parks/Pages/WildlifeAreaMap.aspx.
- National Natural Landmarks range in size from 60 acres to almost 380,000 acres, and are owned by the USFS, BLM, Bureau of Reclamation, NPS, and state, municipal and private organizations (NPS, 2012a). To learn more about Colorado’s National Natural Landmarks, see www.nature.nps.gov/nnl/state.cfm?State=CO.

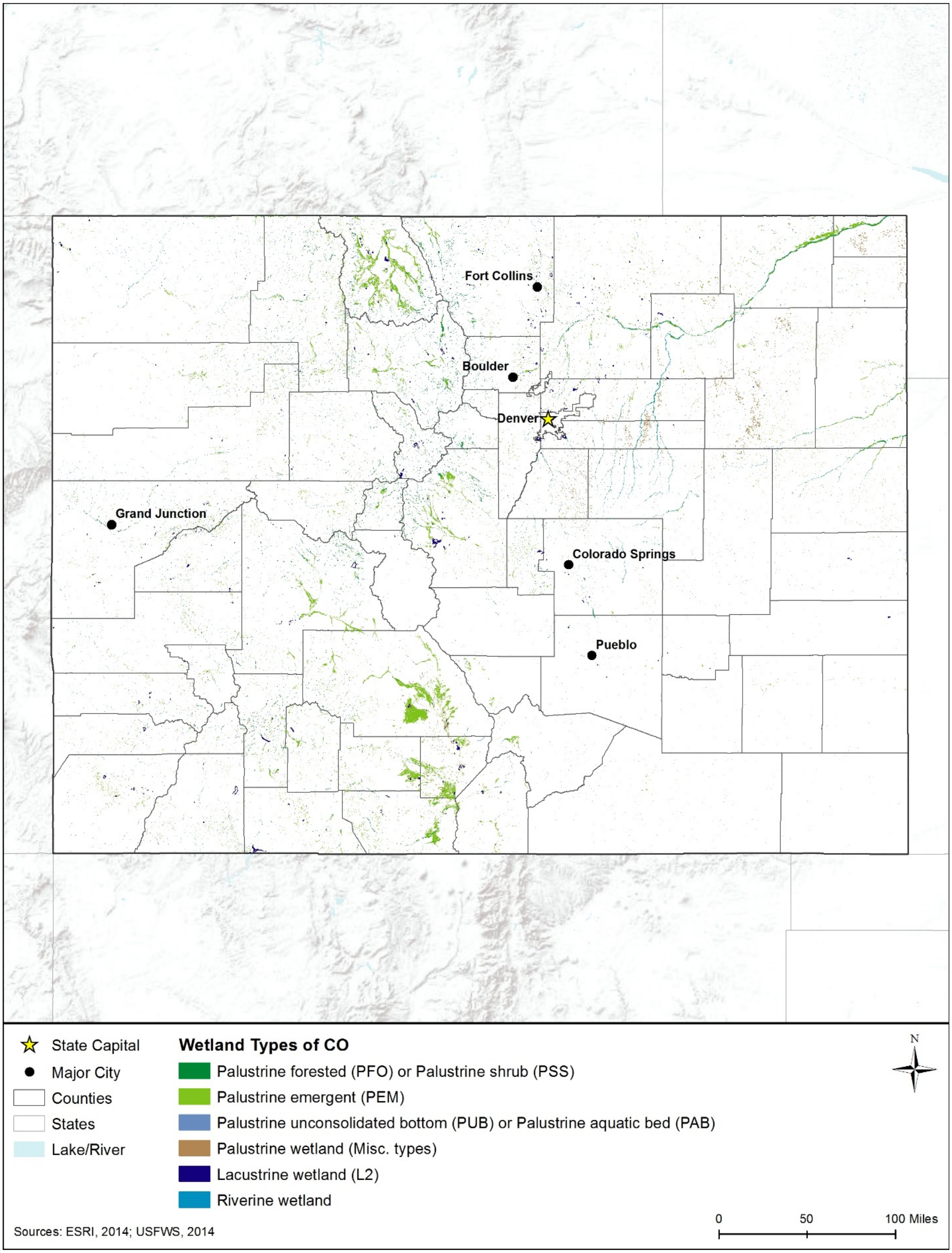

Figure 3.1.5-1: Wetlands by Type, in Colorado, 2014

- Other wetlands protected under easements or agreements through voluntary government programs and resource conservation groups are found across the state, including Natural Resources Conservation Service (NRCS) Agricultural Conservation Easement Program, Farm Service Agency Conservation Reserve Program, Colorado Division of Wildlife (CDOW), land trusts such as Colorado Cattlemen's Agricultural Land Trust and Palmer Land Trust, and easements managed by natural resource conservation groups such as The Nature Conservancy, Rocky Mountain Elk Foundation, and Colorado Wildlife Heritage Foundation. According to the National Conservation Easement Database, a national electronic repository of government and privately held conservation easements (http://conservationeasement.us/), NRCS holds nearly 50,000 acres in conservation easements in Colorado (NCED, 2015).

For more information on Colorado's wildlife management areas, National Natural Landmarks, conservation programs, and easements, see Section 3.1.8, Visual Resources, and Section 3.1.7, Land Use.

3.1.6. Biological Resources

3.1.6.1. Definition of the Resource

This chapter describes the biological resources of Colorado. Biological resources include terrestrial[76] vegetation, wildlife, fisheries and aquatic habitats,[77] and threatened[78] and endangered[79] species as well as species of conservation concern. Wildlife habitat and associated biological ecosystems are also important components of biological resources. Because of the significant topographic variation within the state, Colorado supports a wide diversity of biological resources ranging from prairie settings in the eastern portion of the state, to montane forests and alpine meadows in the mountainous areas of central and western Colorado. Each of these topics is discussed in more detail below.

3.1.6.2. Specific Regulatory Considerations

The proposed project must meet the requirements of NEPA and other applicable laws and regulations. Pertinent federal laws relevant to the protection and management of biological resources in in Colorado are summarized in Appendix C, Environmental Laws and Regulations. Table 3.1.6-1 summarizes the major state laws relevant to the state's biological resources.

[76] Terrestrial: "Pertaining to the land" (USEPA, 2015p).
[77] Habitat: "The environment in which an organism or population of plants or animals lives; the normal kind of location inhabited by a plant or animal" (USEPA, 2015p).
[78] 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))
[79] 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))

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

State Law/Regulation	Regulatory Agency	Applicability
Colorado Noxious Weed Act (CRS 35-5.5-101 through 119)	Colorado Department of Agriculture	Designates and classifies noxious weeds into categories for immediate eradication, containment, and suppression applicable on both public and private lands; state coordinator assists in building local coalitions and coordinating efforts of state, local, and private landowners in developing plans; county and city governments able to implement management programs.
Colorado Aquatic Nuisance Species Act (CRS 33-10.5-101 through 108)	Colorado Parks and Wildlife	Establishes program for detecting, preventing, containing, controlling, monitoring, and eradicating aquatic nuisance species from Colorado.
The Nongame and Endangered, or Threatened Species Conservation Act (CRS 33-2-101 through 108)	Colorado Parks and Wildlife	Provides protection and management of non-game, native wildlife species that are endangered or threatened within the state; requires the state to assist in protecting species that are considered threatened and endangered in other areas and to appropriate funding for the conservation of all protected species from the general fund.

3.1.6.3. Terrestrial Vegetation

The distribution of flora[80] within the state is a function of the characteristic geology,[81] soils, climate, and water of a given geographic area and correlates to distinct areas identified as ecoregions.[82] 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; they depict a general area with similar ecosystem types, functions, and qualities (NWF, 2015) (USDA, 2015a) (World Wildlife Fund, 2015).

Ecoregion boundaries often coincide with physiographic[83] regions of an area. The ecoregions mapped by the USEPA are the most commonly referenced, although individual states and organizations have also developed ecoregions that may differ slightly from those designated by the USEPA. The USEPA divides North America into 15 broad Level I ecoregions. These Level I ecoregions are further divided into 50 Level II ecoregions. These Level II ecoregions are further divided into 182 smaller Level III ecoregions. This Section provides an overview of the terrestrial vegetation resources for Colorado at USEPA Level III. (USEPA, 2016a)

As shown in Figure 3.1.6-1, the USEPA divides Colorado into six Level III ecoregions. The six ecoregions support a variety of different plant communities, all predicated on their general

[80] The plants of a particular region, habitat, or geological period.
[81] 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.
[82] Ecoregion: "A relatively homogeneous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables." (USEPA, 2015q)
[83] Physiographic: "The natural, physical form of the landscape." (USEPA, 2015q)

location within the state. Communities range from coniferous forest and alpine communities in the Southern Rockies region in central Colorado, to prairie and agricultural cropland communities in the High Plains region within the eastern portion of the state. Areas in the Southwestern Tablelands, Arizona/New Mexico Plateau, and Colorado Plateau are influenced further by the dry climates found in these regions. Table 3.1.6-1 provides a summary of the general abiotic[84] characteristics, vegetative communities, and the typical vegetation found within each of the six Colorado ecoregions.

Communities of Concern

Colorado contains vegetative communities of concern that include rare natural plant communities, plant communities with greater vulnerability or sensitivity to disturbance, and communities that provide habitat for rare plant and wildlife species. The ranking system for these communities gives an indication of the relative rarity, sensitivity, uniqueness, or vulnerability of these areas to potential disturbances. This ranking system also gives an indication of the level of potential impact to a particular community that could result from implementation of an action.

The Colorado Natural Heritage Program (CNHP) statewide inventory includes lists of all types of natural communities known to occur within the state. Each natural community is assigned a rank based on its rarity and vulnerability. As with most state heritage programs, the CNHP ranking system assesses rarity using a state rank (S1, S2, S3, S4, S5) that indicates its current or historical relative rarity or endangerment within Colorado. CNHP staff determine and categorize communities into the ranking system. Communities ranked as an S1 by the CNHP are of the greatest concern. This rank is typically based on the community consisting of five or fewer occurrences in the state but other factors may be considered when assigning the rank (CNHP, 2013).

Fifty-nine vegetative communities are ranked as S1 communities[85] in Colorado; these communities represent the rarest terrestrial habitat in the state (CNHP, 2016). These communities have been documented in all six of the Colorado Level III USEPA Ecoregions. Colorado Appendix B, Communities of Concern Table B-1 provides a description of the S1 communities in Colorado, along with their distribution and the associated USEPA Level III ecoregions.

[84] 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, 2016h)
[85] S1 – Communities "State critically imperiled; typically five or fewer EOs." (CNHP, 2016)

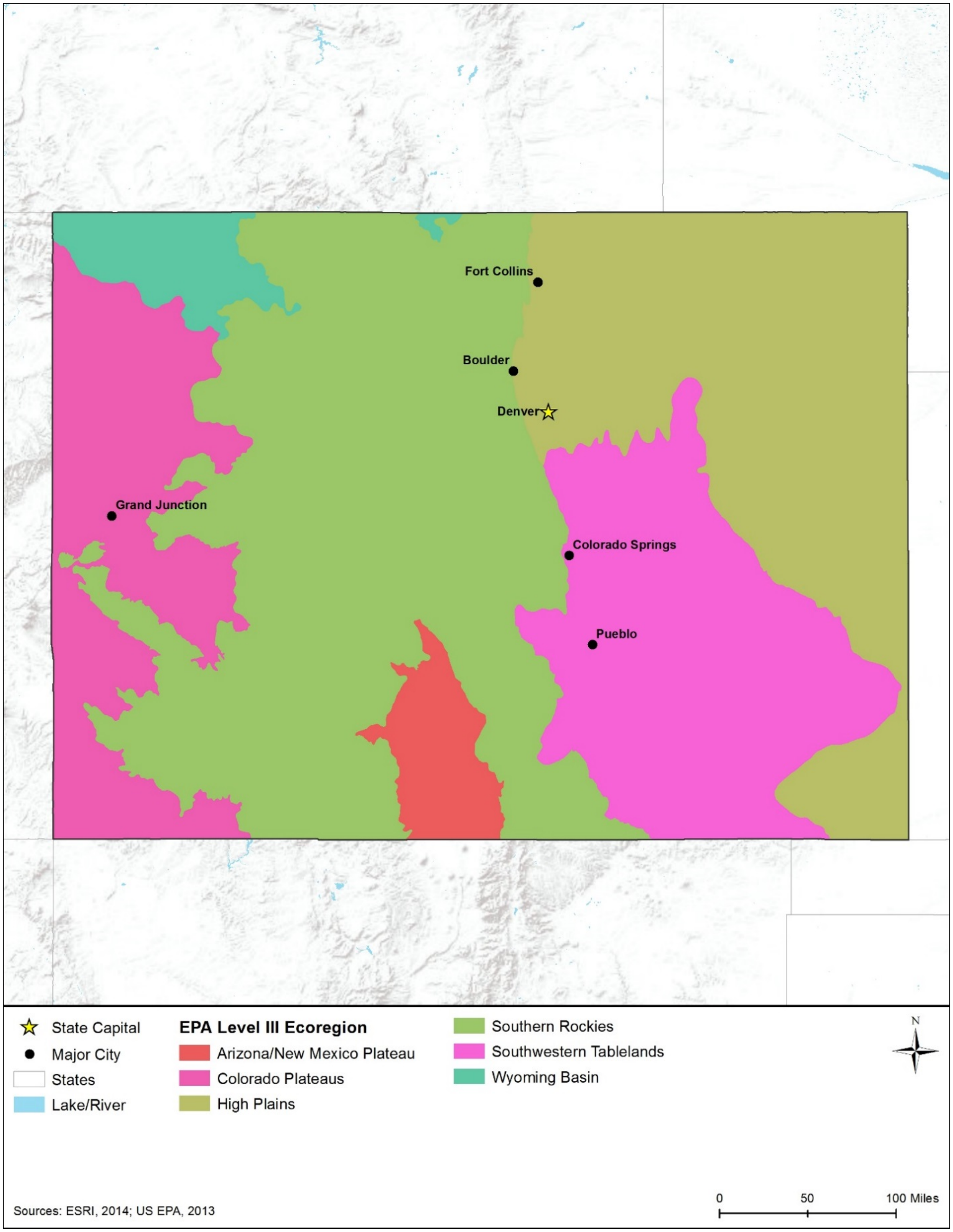

Figure 3.1.6-1: USEPA Level III Ecoregions in Colorado

Table 3.1.6-2: USEPA Level III Ecoregions of Colorado

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
Geographic Region: Southern Rockies				
18	Wyoming Basin	An intermontane basin composed of arid grasslands and shrublands.	Grasslands/Semi-desert Shrublands	**Hardwood Trees -** Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*)
20	Colorado Plateaus	An uplifted, eroded tableland with pinyon-juniper and Gambel oak woodlands at higher elevations and saltbrush-greasewood vegetation in low-lying areas.	Grasslands/Semi-desert Shrublands, Foothills, Montane	**Hardwood Trees -** gambel oak (*Quercus gambleii*) **Conifer Trees -** pinyon pine (*Pinus edulis*) **Shrubs** - shadscale (*Atriplex confertifolia*), big sagebrush (*Artemisia tridentata*), greasewood (*Sarcobatus* spp.) **Forbs/Grasses -** Indian ricegrass (*Oryzopsis hymenoides*)
21	Southern Rockies	A steep, rugged, mountainous region that follows elevational banding with grassland and shrublands at lowest elevations, various woodlands at middle elevations, and coniferous forests at the highest elevations.	Montane, Subalpine, Alpine	**Hardwood Trees** - quaking aspen (*Populus tremuloides*), gambel oak (*Quercus gambelii*) **Conifer Trees** - Englemann spruce (*Picea engelmannii*), ponderosa pine (*Pinus ponderosa*), sub-alpine fir (*Abies lasiocarpa*), Douglas-fir **Shrubs -** sagebrush (*Artemisia* spp.), snowberry (*Symphoricarpos* spp.), mountain mahogany (*Cercocarpus* spp.) **Forbs/Grasses** - kinnickinnick (*Arctostaphyllos uva-ursi*), wheatgrass (*Pascopyrum* spp.)
22	Arizona/New Mexico Plateau	A transitional region with topography ranging from flat plains to tablelands.	Grasslands/Semi-desert Shrublands, Foothills	**Shrubs -** rubber rabbitbrush (*Ericameria nauseosa*), big sagebrush, fourwing saltbush (*Atriplex canescens*), greasewood **Forbs/Grasses -** prairie sunflower (*Helianthus petiolaris*), indian whitegrass (*Leersia virginica*), blue grama (*Bouteloua gracilis*)
Geographic Region: High Plains				
25	High Plains	A flat, smooth grassland to slightly irregular with some natural areas, but mostly comprised of cropland. Gas and oil fields are scattered throughout the area also.	Grasslands/Semi-desert Shrublands	**Hardwood Trees** - cottonwood (*Populus* spp.) **Forbs/Grasses -** blue grama, buffalograss (*Bouteloua dactyloides*), little bluestem (*Schizachyrium scoparium*), western wheatgrass (*Pascopyrum smithii*), fringed sage (*Artemisia frigida*)

Ecoregion Number	Ecoregion Description	Abiotic Characterization	General Vegetative Communities	Typical Vegetation
26	Southwestern Tablelands	A transitional region with red hued-canyons[86], mesas[87], badlands[88], and meandering, braided rivers. Much of the region contains sub-humid grasslands and semiarid rangeland, and contains little cropland.	Grasslands/Semi-desert Shrublands, Foothills	**Deciduous trees** - gambel oak **Conifer trees** - juniper (*Juniperus* spp.), pinyon pine, ponderosa pine **Herbaceous** - blue grama, buffalograss, little bluestem, western wheatgrass

Sources: (Chapman, et al., 2006) (CSU-Extension, 2013)

[86] Canyon: "A narrow chasm with steep walls, formed by running water." (NPS, 2015b)
[87] Mesa: "An isolated, high plateau with a flat top and steep sides that has been separated by the widening of canyons." (NPS, 2015b)
[88] Badlands: "Form when soft sedimentary rock is extensively eroded in a dry climate." (NPS, 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 weeds are typically non-native species that have been introduced into an ecosystem inadvertently; however, on occasion native species can be considered a noxious weed. Noxious weeds greatly affect agricultural areas, forest management, natural, and other open areas (Government Printing Office, 2011). The U.S. government has designated certain plant species as noxious weeds in accordance with the Plant Protection Act of 2000 (7 U.S.C. § 7701 et seq.). As of September 2014, 112 federally recognized noxious weed species have been catalogued in the U.S., (88 of terrestrial, 19 aquatic, and 5 parasitic) (USDA, 2015b), of which 102 are known to occur in Colorado.

Noxious weeds are a threat to agricultural lands, the state economy, recreation, native wildlife species habitat, and other natural resources (CDA, 2015a). The Colorado Noxious Weed Act (CRS 35-5.5-101 through 119) stipulates that the Colorado Department of Agriculture (CDA) be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. In addition, the Colorado Noxious Weed Act further stipulates that each county may implement and enforce noxious weed management. The state provides funding for local entities to carry out management activities such as writing a management plan or carrying out management activities on the ground. Further, the state and counties involved coordinate with neighboring states to assist in preventing the spread of noxious weeds over state boundaries (CDA, 2015b). A total of 78 state-listed noxious weeds and 24 additional plants (on a "Watch-List") are regulated in Colorado (CDA, 2015c). Four of these species occur on the Federal Noxious Weed List (USDA, 2015b). Of these species, 14 are aquatic, 2 are shrubs, and 86 are terrestrial. The following species by vegetation type are regulated in Colorado:

- **Aquatic –** Brazilian elodea (*Egeria densa*), common reed (*Phragmites australis*), Euraisan watermilfoil (*Myriophyllum spicatum*)**,** garden loosestrife (*Lysimachia vulgaris*), giant reed (*Arundo donax*), giant salvinia (*Salvinia molesta*), hairy willow-herb (*Epilobium hirsutum*), hydrilla (*Hydrilla verticillata*), parrotfeather (*Myriophyllum aquaticum*), poison hemlock (*Conium maculatum*), purple loosestrife (*Lythrum salicaria*), water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), yellow floatingheart (*Nymphoides peltata*).
- **Shrubs –** Russian olive (*Elaeagnus angustifolia*) and salt cedar (*Tamarix spp.*).
- **Terrestrial Forbs and Grasses –** absinthe wormwood (*Artemesia absinthium*), African rue (*Peganum harmala*), Asian mustard (*Brassica tournefortii*), baby's breath (*Gypsophila paniculata*), Bathurst burr (*Xanthium spinosum*), black henbane (*Hyoscayamus niger*), bohemian knotweed (*Polygonum x bohemicum*), bouncingbet (*Saponaria officinalis*), bulbous bluegrass (*Poa bulbosa*), bull thistle (*Cirsium vulgare*), camelthorn (*Alhagi pseudalhagi*), Canada thistle (*Cirsium arvense*), chicory (*Cichorium intybus*), Chinese

clematis (*Clematis orientalis*), common bugloss (*Anchusa officinalis*), common burdock (*Arctium minus*), common crupina (*Crupina vulgaris*), common mullein (*Verbascum thapsus*), common St. Johnswort (*Hypericum perforatum*), common tansy (*Senecio jacobaea*), common teasel (*Dipsacus fullonum*), corn chamomile (*Anthemis arvensis*), cutleaf teasel (*Dipsacus laciniatus*), cypress spurge (*Euphorbia cyparissias*), Dalmatian toadflax (broad- and narrow-leaved) (*Linaria dalmatica*), Dame's rocket (*Hesperis matronalis*), diffuse knapweed (*Centaurea diffusa*), downy brome (*Bromus tectorum*), Dyer's woad (*Isatis tinctoria*), elongated mustard (*Brassica elongata*), field bindweed (*Convolvulus arvensis*), flowering rush (*Butomus umbellatus*), halogeton (*Halogeton glomeratus*), Himalayan blackberry (*Rubus armeniacus*), hoary cress (*Cardaria draba*), houndstongue (*Cynoglossum officinale*), garlic mustard (*Alliaria petiolata*), giant knotweed (*Polygonum schalinense*), Japanese blood grass (*Imperata cylindrical*), Japanese knotweed (*Polygonum cuspidatum*), johnsongrass (*Sorghum halepense*), jointed goatgrass (*Aegilops cylindrical*), leafy spurge (*Euphorbia esula*), mayweed chamomile (*Anthemis cotula*), meadow knapweed (*Centaurea pratensis*), meadow hawkweed (*Hieracium aurantiacum*), Mediterranean sage (*Salvia aethiopis*), medusahead (*Taeniatherum caput-medusae*), moth mullein (*Verbascum blattaria*), musk thistle (*Carduus nutans*), myrtle spurge (*Euphorbia myrsinites*), orange hawkweed (*Hieracium aurantiacum*), onionweed (*Asphodelus fistulosus*), oxeye daisy *(Leucanthemum vulgare)*, perennial pepperweed (*Lepidium latifolium*), perennial sowthistle (*Sonchus arvensis*), plumeless thistle (*Carduus acanthoides*), puncturevine (*Tribulus terrestris*), purple pampasgrass (*Cortideria jubata*), rush skeletonweed (*Chondrilla juncea*), quackgrass (*Elytrigia repens*), redstem filaree (*Erodium cicutarium*), Russian knapweed (*Acroptilon repens*), scentless chamomile (*Tripleurospermum perforata*), scotch broom (*Cytisus scoparius*), scotch (*Onopordum acanthium, O. tauricum*), sericea lespedeza (*Lespedeza cuneata*), spotted knapweed (*Centaurea stoebe*), spotted x diffuse knapweed hybrid (*Centaurea x psammogena = C. stoebe x C. diffusa*), sulfur cinquefoil (*Potentilla recta*), squarrose knapweed (*Centaurea virgata*), swainsonpea (*Sphaerophysa salsula*), Syrian beancaper (*Zygophyllum fabago*), tansy ragwort (*Senecio jacobaea*), velvetleaf (*Abutilon theophrasti*), white bryony (*Bryonia alba*), wild caraway (*Carum carvi*), wild proso millet (*Panicum miliaceum*), woolly distaff thistle (*Carthamus lanatus*), yellow flag iris (*Iris pseudacorus*), yellow nutsedge (*Cyperus esculentus*), yellow starthistle (*Centaurea solstitialis*), yellow toadflax (*Linaria vulgaris*), and yellowtufts (*Alyssum murale, A. corsicum*).

3.1.6.4. Terrestrial Wildlife

This section discusses the terrestrial wildlife species in Colorado, divided among mammals,[89] birds,[90] reptiles[91] and amphibians,[92] and invertebrates.[93] Terrestrial wildlife consist of those species, and their habitats, that live predominantly on land. Terrestrial wildlife include common big game species, small game animals, furbearers,[94] nongame animals, game birds, waterfowl, and migratory birds, as well as their habitats within Colorado. A discussion of non-native and/or invasive terrestrial wildlife species is also included within this section. Information regarding the types and location of native and non-native/invasive wildlife is useful for assessing the importance of any impacts to these resources or the habitats they occupy. According to Colorado Parks and Wildlife (CPW) the state is home to 960 native species that includes mammals, fish, reptiles, birds, amphibians, mollusks and crustaceans. Of the native species, 186 are pursued recreationally and 740 (excluding insects and arachnids) are non-game wildlife species (CPW, 2015b) (Colorado State University, 2016) (PIF, 2000).

Mammals

Common and widespread mammalian species in Colorado include the black-tailed prairie dog (*Cynomys ludovicianus*), mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis*). Most mammals are widely distributed in the state; however, there are some species, such as the big horn sheep (*Ovis canadensis*) and mountain goat (*Oreamnos americanus*) that are found primarily in the mountainous areas in the western portion of the state (CPW, 2015b). A number of threatened and endangered mammals are located in Colorado. Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

In Colorado white-tailed deer *(Odocoileus virginianus)*, mule deer, elk, moose (*Alces alces*), pronghorn (*Antilocapra americana*), big horn sheep (*Ovis canadensis*), mountain goat, mountain lion (*Puma concolor*), and black bear (*Ursus americanus*) are classified as big game species, whereas small game species include small mammals (e.g., squirrels and rabbits), furbearers, and upland and migratory game birds (CPW, 2016a) (CPW, 2016b) (CPW, 2015d). The following 20 species of furbearers may be legally hunted or trapped in Colorado: badger (*Taxidea taxus*), beaver (*Castor canadensis*), bobcat *(lynx rufus)*, cottontail rabbits (*Sylvilagus* spp.), jackrabbits (*Lepus spp*.), snowshoe hare (*Lepus americanus*), squirrels *(Sciuridae)*, prairie dogs (*Cynomys spp*.), coyote (*Canis latrans*), marmot (*Marmota spp*.), mink (*Neovison vison*), marten (*Martes spp*.), grey fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), swift fox (*Vulpes velox*),

[89] Mammals: "Warm-blooded vertebrates that give birth to and nurse live young; have highly evolved skeletal structures; are covered with hair, either at maturity or at some stage of their embryonic development; and generally have two pairs of limbs, although some aquatic mammals have evolved without hind limbs." (USEPA, 2015p)
[90] Birds: "Warm-blooded vertebrates possessing feathers and belonging to the class Aves." (USEPA, 2015p)
[91] Reptile: "Cold-blooded, air-breathing vertebrates belonging to the class Reptilia usually covered with external scales or bony plates." (USEPA, 2015p)
[92] Amphibian: "A cold-blooded vertebrate that lives in water and on land. Amphibians' aquatic, gill-breathing larval stage is typically followed by a terrestrial, lung-breathing adult stage." (USEPA, 2015p)
[93] Invertebrates: "Animals without backbones: e.g., insects, spiders, crayfish, worms, snails, mussels, clams, etc." (USEPA, 2015p)
[94] Furbearer is the name given to mammals that traditionally have been hunted and trapped primarily for fur.

ring-tailed cat (*Bassariscus astutus*), raccoon (*Procyon lotor*), skunk *(Mephitidae caniformia),* weasel (*Mustela* spp.), and muskrat (*Ondatra zibethicus*) (CPW, 2016a) (CPW, 2015d).

Colorado has identified 36 mammals as Species of Greatest Conservation Need (SGCN). The SGCN list consists of at-risk species that are in need of most attention. Proposed species for the SGCN list were evaluated by analyzing several inclusion and exclusion criterion. Although these species have been targeted for conservation they are not currently under legal protection because of the SGCN listing. The SGCN list is updated periodically and is used by the state of Colorado to focus their conservation efforts and as a basis for implementing their State Wildlife Action Plan (SWAP). CPW is currently updating their SWAP. (CPW, 2015e)

Birds

The number of native bird species documented in Colorado varies according to the timing of the data collection effort, changes in bird taxonomy,[95] and the reporting organization's method for categorizing occurrence and determining native versus non-native status. Further, the diverse ecological communities (i.e., mountains, large rivers and lakes, plains, etc.) found in Colorado support a large variety of bird species.

A total of 464 species of resident and migratory birds have been documented in Colorado, with 278 of those species known to have breeding populations[96] in the state of Colorado (PIF, 2000). Among the 464 extant[97] species in Colorado, 61 SGCN have been identified (CPW, 2015e).

Colorado is located within both the Central and Pacific Flyways. Covering the eastern two-thirds of Colorado, the Central Flyway spans from the Gulf Coast of Texas to the Canadian boreal forest. The Pacific Flyway covers the western third of Colorado and spans from the west coast of Mexico to the Arctic. Large numbers of migratory birds utilize these flyways and other migration corridors and pathways throughout the state each year during their annual migrations northward in the spring and southward in the fall. "The Migratory Bird Treaty Act (MBTA) makes it illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid permit issued pursuant to federal regulations" (USFWS, Birds protected by the migratory bird treaty act, 2013a). The USFWS is responsible for enforcing the MBTA and maintaining the list of protected species. The migratory bird species protected under the MBTA are listed in 50 CFR 10.13 (USFWS, 2013a).

Bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are protected under the Bald and Golden Eagle Protection Act. Bald eagles are generally found near large rivers and lakes in the throughout the state all year round (eBird, 2015a). Golden eagles generally nest in mountains and cliffs. Golden eagles are also found throughout the state all year round (eBird, 2015b).

[95] Taxonomy: "A formal representation of relationships between items in a hierarchical structure." (USEPA, 2015p)
[96] Population: "Aggregate of individuals of a biological species that are geographically isolated from other members of the species and are actually or potentially interbreeding." (USEPA, 2015p)
[97] Extant: "A species that is currently in existence (the opposite of extinct)." (USEPA, 2015p)

A number of Important Bird Areas (IBAs) have also been identified in Colorado, as can be seen in Figure 3.1.6-2. The IBA program is an international bird conservation initiative with a goal of identifying the most important places for birds, and to conserve these areas. IBAs assist in achieving local conservation priorities to provide important habitat for native bird populations during breeding,[98] migratory stops, feeding, and over-wintering areas (National Audubon Society, 2015a). IBAs are identified according to standardized, scientific criteria through a collaborative effort among state, national, and international conservation-oriented non-governmental organizations (NGOs), state and federal government agencies, local conservation groups, academics, grassroots environmentalists, and bird-watchers. IBAs link global and continental bird conservation priorities to local sites that provide critical habitat for native bird populations. IBA priority areas are based on a number of specific criteria. Generally, global IBAs are sites determined important for globally rare species or support bird populations at a global scale. Continental IBAs are sites determined important for continentally rare species or support bird populations at a continental scale, but do not meet the criteria for a global IBA. State IBAs are sites determined important for state rare species or that support local populations of birds.

According to the Audubon Society, a total of 54 IBAs have been identified in Colorado, including breeding,[99] migratory stop-over, feeding, and over-wintering areas, and a variety of habitats such as native grasslands, grasslands, sage brush, and wetland/riparian areas (National Audubon Society, 2016). These IBAs are widely distributed throughout the state, and comprise over 1,200,000 acres of land in areas such as Rocky Mountain National Park and Pawnee National Grasslands. IBA habitats vary greatly in the state and range from grasslands, sagesteppe shrublands, to montane forests. The largest IBA in the state is the Gunnison Basin, located in western Colorado, which is an important area for the Gunnison sage grouse (*Centrocercus minimus*). This area provides habitat for approximately 2,500 of the remaining worldwide population of 4,000 Gunnison sage grouse (National Audubon Society, 2016).

A number of threatened and endangered birds are located in Colorado, including the Gunnison sage grouse, as mentioned above. Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern, identifies these protected species.

Reptiles and Amphibians

Over 70 native reptile and amphibian species occur in Colorado from wood frogs to lizards, snakes, and turtles (CPW, 2015f). These species occur in a wide variety of habitats from the arid plains in the east to coniferous forests in the Rocky Mountains. Very few species are widespread throughout the state, and are instead more commonly found in either the plains region in the east

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

or the mountainous region in the west. Of these species, 26 SGCN have been identified (CPW, 2015e).

Colorado's reptile and amphibian species are classified as non-game species except for the prairie rattlesnake (*Crotalus viridis*), larval tiger salamander (*Ambystoma tigrinum*), and snapping turtle (*Chelydra serpentine*) (CPW, 2015l) (CPW, 2016c). Non-native bullfrog (*Lithobates catesbeianus*) are also considered game species throughout the year (CPW, 2016c). Other species that are non-native to Colorado and used for pet and hobby purposes are unregulated if established in the wild. All other species are considered non-game and hunting or fishing is only allowed under special circumstances.

Invertebrates

Colorado is home to thousands of species of invertebrates, including a wide variety of bees, hornets, wasps, butterflies, moths, beetles, flies, dragonflies, damselflies, spiders, mites, and nematodes. These invertebrates provide an abundant food source for mammals, birds, reptiles, amphibians, and other invertebrates. In Colorado, invertebrate abundance varies by season, elevation, weather, and the time of day (SJMA, 2009). In the U.S., one-third of all agricultural output depends on pollinators.[100] In natural systems, the size and health of the pollinator population is linked to ecosystem health, with a direct relationship between pollinator diversity and plant diversity. Bees are pollinators of wild land plants and crops, especially peppers, tomatoes, eggplants, berry, fruit, and seed crops (Kock, Strange, & Williams, 2012). "As a group, native pollinators are threatened by habitat loss, pesticides, disease, and parasites" (NRCS, 2009). It is estimated that 286 butterfly species and 325 moth species occur in Colorado (BMNA, 2015). A total of 76 SGCN have been identified in Colorado (CPW, 2015e).

Invasive Wildlife Species

Colorado has adopted regulations that prohibit or regulate the possession, transport, sale, barter, or trade of select wildlife species that are considered detrimental to native wildlife species. The list of species is presented in CRS 406-0:008.B (Code of Colorado Regulations, 2016). The prohibited species list includes 2 bird species and 17 mammal species. Invasive wildlife species are important to consider when proposing a project since project activities may result in conditions that favor the growth and/or spread of invasive wildlife populations. These situations may result from directly altering the landscape or habitat to a condition that is more favorable for an invasive species, or by altering the landscape or habitat to a condition that is less favorable for a native species.

Species such as the gypsy moth (*Lymantria dispar*), hemlock woolly adelgid (*Adelges tsugae*), Asian longhorn beetle (*Anoplophora glabripennis*), and emerald ash borer are of particular concern in Colorado and are known to cause irreversible damage to native forests. (USFS, 2015g)

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

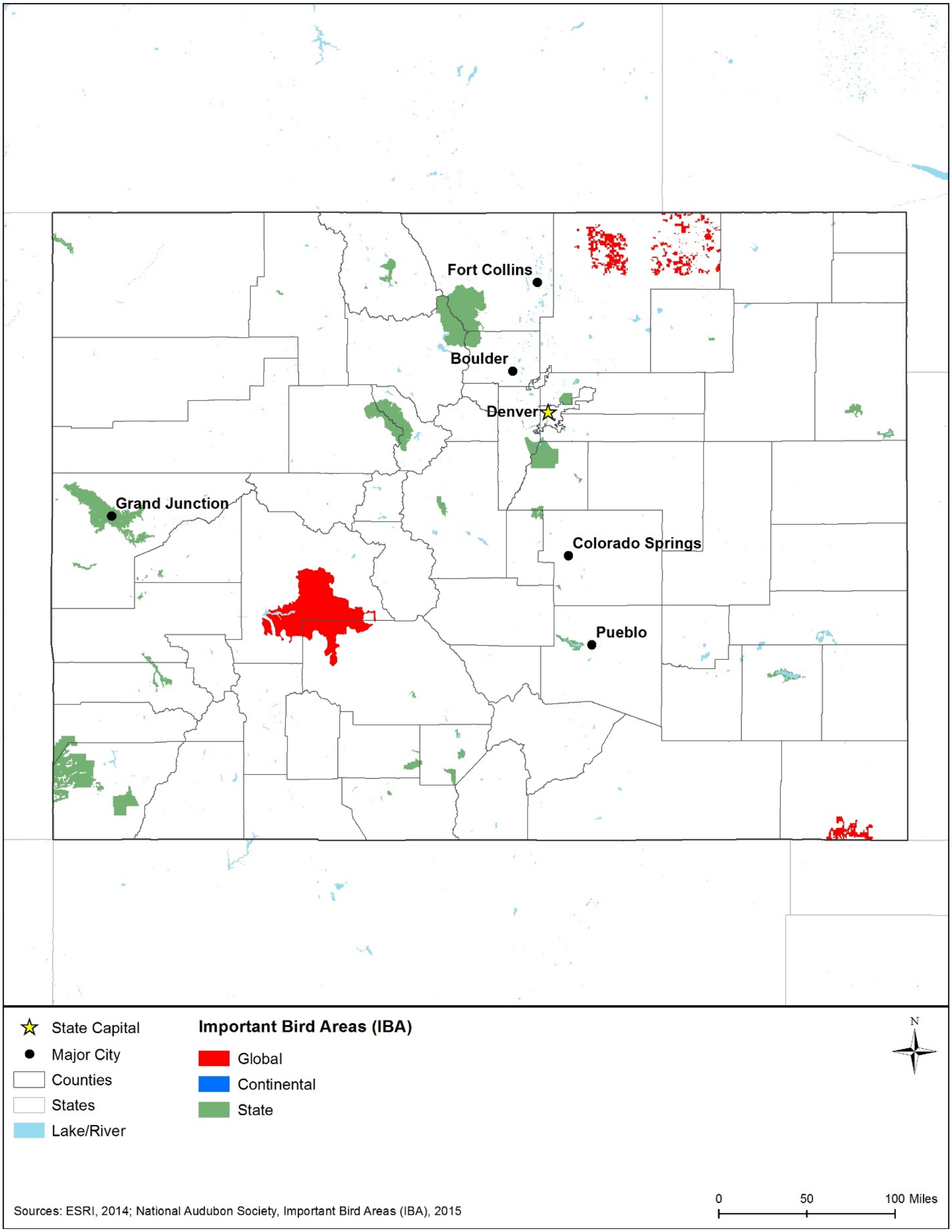

Figure 3.1.6-2: Important Bird Areas (IBAs) of Colorado

3.1.6.5. Fisheries and Aquatic Habitat

This section discusses the aquatic wildlife species in Colorado, including freshwater fish and invertebrates. A summary of non-native and/or invasive aquatic species is also presented. A distinctive feature of the Colorado landscape with regard to aquatic wildlife is the cold-water trout streams and rivers west of the Continental Divide. These water bodies, often fed by snowmelt, provide habitat for a variety of aquatic wildlife that require a high dissolved oxygen content and low sediment load (Denver Water, 2016) (USDA, 2016a). No essential fish habitat (EFH) identified by the Magnuson-Stevens Fishery Conservation and Management Act exists in the state of Colorado (NOAA, 2016). Critical habitat for threatened and endangered fish species, as defined by the ESA, does exist within Colorado and is discussed in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

Freshwater Fish

Colorado is known for its freshwater fishing and is home to breeding populations of many species (CPW, 2016c). Overall, over 35 warm- and cold-water fish species have been documented in Colorado for recreational fishing (CPW, 2016d). Fish species range from small species like the orange throat darter (*Etheostoma spectabile*) to large fish such as the Colorado pikeminnow (*Ptychocheilus lucius*) (CPW, 2015o). Colorado has identified 27 fish species as SGCN (CPW, 2015e). These species include, but are not limited to, catfishes, drums, herring-like fishes, mosquitofish, minnows, perch-like fishes, pikes, trout and salmon, sculpins, smelt, sticklebacks, suckers, sunfish and bass, and topminnows (Colorado State University, 2005). A brief description of those families that contain common species, notable sport fish species, or species of concern is listed below.

Catfish species include the black bullhead (*Ameiurus melas*), blue catfish (*Ictalurus furcatus*), brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), stonecat (*Noturus flavus*), and yellow bullhead (*Ameiurus natalis*). Only the stonecat is identified as SGCN (Colorado State University, 2005) (CPW, 2015e).

Approximately 35 species of minnows occur in Colorado, with 14 of them being introduced species. Some minnow species of Colorado include the fathead minnow (*Pimephales promelas*), flathead chub (*Pimephales promelas*), bigmouth shiner (*Notropis dorsalis*), longnose dace (*Rhinichthys cataractae*), and lake chub (*Couesius plumbeus*) (Colorado State University, 2005). This family contains 13 SGCN, including bonytail chub (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*), brassy minnow (*Hybognathus hankinsoni*), common shiner (*Luxilus cornutus*), flathead chub (*Platygobio gracilis*), humpback chub (*Gila cypha*), plains minnow (*Hybognathus placitus*), northern redbelly dace (*Chrosomus eos*), Rio Grande chub (*Gila pandora*), roundtail chub (*Gila robusta*), southern redbelly dace (*Chrosomus erythrogaster*), and suckermouth minnow (*Phenacobius mirabilis*) (CPW, 2015e). Several species are very rare in Colorado and are considered state threatened or endangered. The bonytail chub for instance once was present in the Yampa, Green, Colorado, and Gunnison Rivers, but is now thought to be extirpated in the state of Colorado (USFWS, 2002a). It is considered a state and federally endangered species that is thought to have declined due to damming and channeling of rivers it used for habitat (USFWS, 2002a).

The freshwater drum (*Aplodinotus grunniens*) is the only species of drum in Colorado and it is a non-native species to the state (CPW, 2015b) (Colorado State University, 2005). It was introduced into the Bonny Reservoir in Yuma, County in 1951. This species can be found at the bottom of medium to large rivers and lakes (USGS, 2016c).

The gizzard shad (*Dorosoma cepedianum*) is the only species of herring in Colorado and is considered a native species (CPW, 2015b). However, it is considered non-native in many states west of the Continental Divide. It has been previously documented in the Arkansas, South Platte, and Republican drainages in Colorado (USGS, 2015e).

The western mosquitofish (*Gambusia affinis*) is the only livebearer species in Colorado and is considered non-native in the state (Colorado State University, 2005) (CPW, 2015b). Mosquitofish are small fish that feed on the top of the water column on zooplankton and invertebrates. They are known to eat large quantities of food and can ingest 42 to 167 percent of their body weight in a day. Mosquitofish were originally introduced to control mosquito population, but spread across the country (USGS, 2016d).

A total of seven species of perches occur in Colorado, including large members such as walleye (*Sander vitreus*) and sauger (*Sander canadensis*). Three species are considered SGCN, the Arkansas darter (*Etheostoma cragini*), Iowa darter (*Etheostoma exile*), and plains orange throat darter (CPW, 2015b). The Arkansas darter is a federal candidate for listing and is a Colorado threatened species. The species is related to walleye, but is much smaller, averaging about three inches in length. It has been documented in numerous drainages in Colorado, including the Arkansas River, and is found in shallow streams with sandy substrates and rooted aquatic vegetation (CPW, 2015b).

Three species of pikes/pickerals occur in Colorado’s waters, the northern pike (*Esox lucius*), the muskellunge (*Esox masquinongy*), and the tiger muskellunge (*Esox masquinongy x Esox lucius*). All three species are considered non-native in Colorado (CPW, 2015b). Northern pike are aggressive predators and may prey upon native fish, ultimately altering entire aquatic communities. In Colorado, the species was stocked in Elkhead Reservoir in 1977, where it then spread to the Yampa and Green Rivers (Finney & Haines, 2008). Tiger muskellunge have been reintroduced into several waterbodies in Colorado. Being a sterile hybrid between the muskellunge and the northern pike, the state intends to use them as a replacement for northern pike for fishing but also to assist with reducing northern pike impacts to threatened and endangered fish (CPW, 2013).

There are 33 salmon species which occur in Colorado, including 28 non-native, and 5 native species. Some species include arctic char (*Salvelinus alpinus*), kokanee salmon (*Oncorhynchus nerka*), mountain whitefish (*Prosopium williamsoni*), various native cutthroat trout species, and non-native trout species (CPW, 2015b). Three species of cutthroat are considered SGCN SGCN (CPW, 2006). The most well-known fish species in Colorado includes its native and non-native trout species. Cutthroat trout (*Oncorhynchus clarkii*) still extant in Colorado include Colorado River cutthroat (*Oncorhynchus clarkii pleuriticus*), greenback cutthroat (*Oncorhynchus clarkii stomias*), and Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). The yellowfin cutthroat (*Oncorhynchus clarkii macdonaldi*) previously inhabited areas in the Arkansas drainage, but is now presumed to be extinct (CPW, 2015c). Some non-native trout species that are important for angling include rainbow trout (*Oncorhynchus mykiss*), lake trout (*Salvelinus namaycush*), brown trout (*Salmo trutta*), and brook trout (*Salvelinus fontinalis*). Kokanee salmon are also important for fishing opportunities and have been stocked in Blue Mesa Reservoir since 1965. The populations have recently declined dramatically due to predation of the species by lake trout (CPW, 2014).

Two sculpin species occur in Colorado, the mottled sculpin (*Cottus bairdii*) and Paiute sculpin (*Cottus beldingi*). Both species are native to Colorado (Colorado State University, 2005) (CPW, 2015b). Sculpins prefer clear, fast-flowing streams and rivers. They can be found throughout the northern Rocky Mountains in the upper Colorado River (Brown, 1982) (USGS, 2015f)

The rainbow smelt (*Osmerus mordax*) is the only species of smelt in Colorado and is a non-native species (Colorado State University, 2005) (CPW, 2015b). The species has been documented in numerous reservoirs located in the South Platte and Arkansas River Drainages and in the Colorado Basin headwaters (Fuller, et al., 2015b). Rainbow smelt have been introduced into Colorado waterways to provide forage for larger recreational fish species, such as walleye. Rainbow smelt can be found in large reservoirs in Colorado, such as Horsetooth Reservoir near Fort Collins, Colorado (Davies, 2013).

Two stickleback species occur in Colorado, including threespine stickleback (*Gasterosteus aculeatus*) and brook stickleback (*Culaea inconstans*). Threespine stickleback is considered non-native and brook stickleback is native to Colorado (CPW, 2015b). Threespine stickleback was thought to be introduced to the west through use as baitfish by anglers. The species may be anadromous[101] near coastal areas, but does not exhibit this characteristic in Colorado (Fuller, et al., 2015a). Limited information is available regarding the distribution of these two species in Colorado.

The sucker family are represented by 19 species in Colorado. Ten species are non-native and 9 are native to Colorado (CPW, 2015b). Five suckers are SGCN in Colorado, the bluehead sucker (*Catostomus discobolus jarrovii*), flannelmouth sucker (*Catostomus latipinnis*), mountain sucker (*Catostomus platyrhynchus*), Rio Grande sucker (*Catostomus plebeius*), and razorback sucker (*Xyrauchen texanus*) (CPW, 2006). The razorback sucker is federally and state endangered, and the Rio Grande sucker is state endangered (CPW, 2015b). Historically, razorback sucker were found throughout the Colorado River system, but are now limited to the Yampa, Colorado, and Gunnison Rivers. Population reductions are likely due to loss of floodplain habitat and non-native fish predation (CPW, 2015b).

The sunfish family have 16 species in Colorado, many of which are highly popular with sport fishermen. Of the 16 total present in Colorado, 14 are non-native to the state. The most commonly encountered species are the bluegill (*Lepomis macrochirus*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), largemouth bass (*Micropterus salmoides*),

[101] Anadromous: "Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn." (USEPA, 2015p)

and smallmouth bass (*Micropterus dolomieu*) (CPW, 2015b). One of the species, orangespotted sunfish (*Lepomis humilis*), is considered an SGCN (CPW, 2006).

Three topminnow species occur in Colorado, including striped killifish (*Fundulus majalis*), plains topminnow (*Fundulus sciadicus*), and northern plains killifish (*Fundulus kansae*). Northern plains killifish and plains topminnow are considered native to Colorado *(CPW 2015c)*. Topminnows are a small group of fish adapted to feed at the water's surface. Northern plains killifish are not considered a species of concern, but could move towards this status due to introduction of non-native species. Plains killifish are native to the eastern half of Colorado, and some introduced populations exist on the western slope as well (Rahel & Thel, 2004).

Shellfish and Other Invertebrates

Colorado is home to 40 aquatic mollusk species, which includes eight gastropod[102] families and three bivalve[103] families (CPW, 2015b). Some species from this list include the big-eared radix (*Radix auricularia*), golden fossaria (*Galba obrussa*), cloaked ancylid (*Ferrissia walker*), and the Rocky Mountain capshell (*Acroloxus coloradensis*) (Harrold & Guralnick, 2010). Nine mollusk species are considered SGCN (CPW, 2006) Limited information is available regarding aquatic invertebrate species in Colorado.

Invasive Aquatic Species

Colorado has adopted regulations that prohibit or regulate the possession, transport, importation, sale, barter, and introduction of select aquatic invasive species, both plants and animals. Importation of aquatic native or non-native species is unallowable without an approved Importation License. It is also illegal to possess certain aquatic species in the state, which are listed in CRS 406-0:012.C (Code of Colorado Regulations, 2016). The list of prohibited aquatic species includes three amphibians, four crustaceans, 23 fish, and seven mollusks (CPW, 2015n). A selection of species are prohibited for release in the state. Some have very specific restrictions regarding where they may or may not be released. For instance, smallmouth bass and northern pike may be released in the Upper Colorado River Basin as long as it is not in critical habitat for a threatened or endangered species. Invasive aquatic species that have been detected in Colorado include the zebra mussel (*Dreissena polymorpha*), northern pike (*Esox lucius*), and *Myxobolus cerebralis*, a parasite that causes whirling disease[104] in salmonids.

3.1.6.6. Threatened and Endangered Species and Species of Conservation Concern

USFWS is responsible for administering the federal Endangered Species Act (ESA) (16 U.S.C. §1531 et seq.) in the state of Colorado. The USFWS has identified 15 federally endangered and 18 federally threatened species known to occur in Colorado (USFWS, 2015c). Of these 37

[102] Gastropods: "Any member of a large class of mollusks (Gastropoda), commonly called snails. Gastropods live in marine, freshwater, and terrestrial habitats. They have a univalve, often spiral shell (or none at all), a muscular foot for locomotion, and distinctive sensory organs." (Smithsonian Institution, 2016)
[103] Bivalve: "A mollusk with a soft body enclosed by two distinct shells that are hinged and capable of opening and closing." (Smithsonian Institution, 2016)
[104] Whirling disease is caused by a microscopic parasite, *Myxobolus cerebralis*, and causes deformities and neural damage to juvenile fish (Steinbach Elwell, Eagle Stromberg, Ryce, & Bartholomew, 2009).

federally listed species, 14 of them have designated critical habitat in Colorado (USFWS, 2015d).[105] Figure 3.1.6-3 depicts the critical habitat in the state of Colorado, the majority of which occurs in western and central Colorado within the Southern Rockies. Five candidate species[106] are identified by USFWS as occurring within the state (USFWS, 2015e). Candidate species are not afforded statutory protection under the ESA. However, the USFWS recommends taking these species into consideration during environmental planning because they could be listed in the future (USFWS, 2014a). The 36 federally listed species include 4 mammals, 9 birds, 5 fish, 2 invertebrates and 16 plants, and are discussed in detail under the following sections (USFWS, 2015c).Federal land management agencies maintain lists of species of concern for their landholdings; these lists are not discussed below as they are maintained independently from the ESA. For future site-specific analysis on those lands, consultation with the appropriate land management agency would be required.

Mammals

One endangered and two threatened mammals are federally listed in Colorado as summarized in Table 3.1.6-3. The Canada lynx *(Lynx canadensis)* may be found in the high forests of the Rocky Mountains, the New Mexico meadow jumping mouse *(Zapus hudsonius luteus)* and Preble's meadow jumping mouse *(Zapus hudsonius preblei)* are found along rivers in southern and central parts of Colorado. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Colorado is provided below.

Table 3.1.6-3: Federally Listed Mammal Species of Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Canada Lynx	*Lynx canadensis*	T	No	Alpine boreal forests of the Rocky Mountains
New Mexico Meadow Jumping Mouse	*Zapus hudsonius luteus*	E	Yes	Certain riparian regions of the Florida River and Lake Navajo in southern Colorado
Preble's Meadow Jumping Mouse	*Zapus hudsonius preblei*	T	Yes	Riparian habitat in the foothills of central Colorado

Source: (USFWS, 2015c)

[a] E = Endangered, T = Threatened

[105] 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*))

[106] 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)

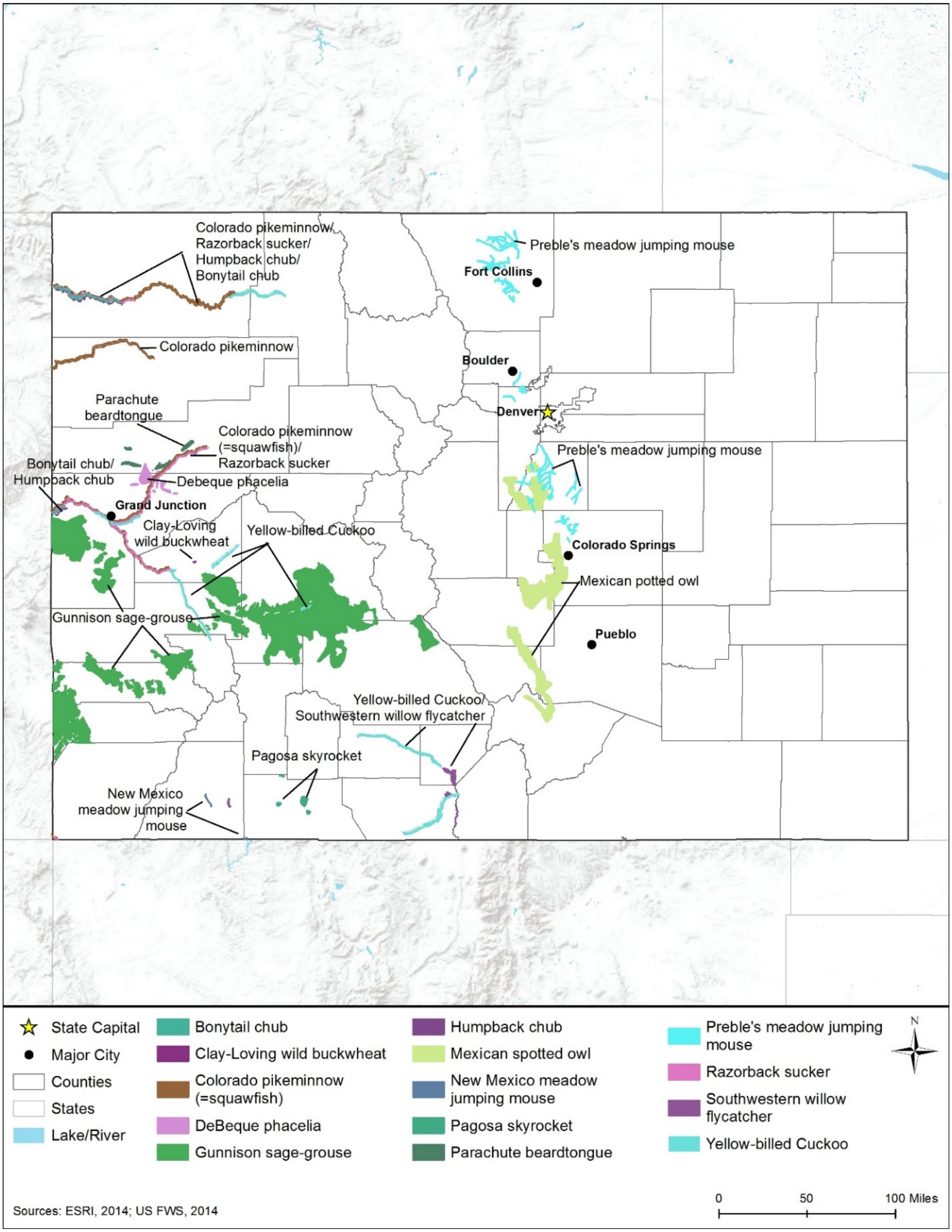

Figure 3.1.6-3: ESA Designated Critical Habitat for Colorado

Canada Lynx. The threatened Canada lynx is an average-sized cat (ranging from 32 to 33.5 inches long and 19 to 22 pounds) with "large, well-furred paws, long, black ear tufts, and a short, black-tipped tail" that separates it from a bobcat (USFWS, 2013e). The Canada lynx was listed in 2000 (65 FR 16053 16086, March 24, 2000) and critical habitat has been designated for this species (79 FR 54781 54846, September 12, 2014) (USFWS, 2014b). 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. Only a few places in the lower 48 states regularly support the Canada lynx populations. Central Colorado is one of these areas, with the majority of lynx habitat occurring on public lands in the Rocky Mountains (USFWS, 2015f).

Primary threats to the Canada lynx include habitat destruction, a lack of regulatory control, and inconsistent guidance for forest management activities. The Canada lynx travels back and forth between the U.S. and Canada; therefore, contiguous habitat is important for this species. Snowshoe hare habitat is also important because of the direct link between snowshoe hare abundance and lynx abundance and survival. While incidental take of lynx from hunting or trapping is a potential threat, available data does not show this to be substantial threat to this species. (USFWS, 2005) (USFWS, 2013e)

New Mexico Meadow Jumping Mouse. The endangered New Mexico meadow jumping mouse has grayish-brown fur and a white belly. The species grows up to 10 inches in length, including its 5-inch bicolored tail. The species was listed as endangered in 2014, (79 FR 33119 33137, June 10, 2014) and, in Colorado, was designated as having critical habitat along Lake Navaho, Lake Maloya, and the Florida River (79 FR 19307 19313, April 8, 2014) (USFWS, 2015g). The species is endemic to New Mexico, Arizona, and parts of southern Colorado, but has been extirpated from much of its historic range (USFWS, 2014c).

The jumping mouse has specific requirements for habitat, nesting in dry soils with riparian vegetation. The jumping mouse is generally nocturnal, but during the summer the jumping mouse may also be seen during the day preparing for hibernation. "The jumping mouse hibernates about nine months out of the year, longer than most other mammals" (USDA, 2016b) Threats to the jumping mouse include specific changes to its habitat such as water shortages or flooding, wildfires, and grazing. (USFWS, 2014c)

Preble's Meadow Jumping Mouse. The threatened Preble's meadow jumping mouse is a small mammal which grows to approximately 9 inches in length with large hind feet adapted for jumping and a 6-inch bicolored tail. It has a dark stripe down the middle of its back which is bordered on either side by gray to orange-brown fur. To evade predators, the mouse can jump up to 3 feet, and on average lives twice as long as mammals of a similar size. Preble's meadow jumping mouse was federally listed as threatened in 1998 (63 FR 26517 26530, May 13, 1998) with critical habitat designated in 2010 (75 FR 78430 78483, December 15, 2010). The species was proposed for delisting in 2013, though findings did not support this conclusion and the threatened status persists. (USFWS, 2015h)

This species is typically found in mature riparian vegetation with adjacent, undisturbed grassland communities and a nearby water source. Historically, the mouse was found in the Platte River Basin and in the headwaters of the Arkansas River Basin. Today, the species is found only in a narrow band of foothills extending from central Colorado to southeastern Wyoming (USFWS, 2014d) (USFWS, 2003a). Threats to the species include fragmentation of habitat, which creates isolated populations, and changes in hydrology (USFWS, 2003a).

Birds

Two endangered and five threatened bird species are federally listed in Colorado, as summarized in Table 3.1.6-4. The Gunnison sage-grouse (*Centrocercus minimus*) and the lesser prairie-chicken *(Tympanuchus pallidicinctus)* are located in the prairie grasslands of southern Colorado; the least tern (*Sterna antillarum), y*ellow-billed cuckoo (*Coccyzus americanus)*, piping plover (*Charadrius melodus),* and southwestern willow flycatcher (*Empidonax traillii extimus)* are riparian species located along riverbanks throughout the state; the Mexican spotted owl (*Strix occidentalis lucida)* is found in central Colorado's forested mountains and canyonlands. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Colorado is provided below.

Table 3.1.6-4: Federally Listed Bird Species of Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Gunnison Sage-grouse	*Centrocercus minimus*	T	Yes	Sagebrush and grasslands of south western Colorado
Least Tern	*Sterna antillarum*	E	No	River banks of the Missouri, Ohio, Red, and Rio Grande River
Lesser Prairie-chicken	*Tympanuchus pallidicinctus*	T	No	Southeastern prairies and grasslands of Colorado
Mexican Spotted Owl	*Strix occidentalis lucida*	T	Yes	Forested mountains and canyonlands throughout central and western parts of Colorado
Piping Plover	*Charadrius melodus*	T	No	Vegetated wetlands, beaches, lakes, or rivers of the Great Plains
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	Yes	Southern portion of the state including shores of the Rio Grande and ConeRivers.
Yellow-billed Cuckoo	*Coccyzus americanus*	T	Yes	Thick canopy of riparian forests, usually cottonwood and willow trees of eastern Colorado

Source: (USFWS, 2015c) (USFWS, 2015e)

[a] E = Endangered, T = Threatened

Gunnison Sage-Grouse. The Gunnison sage-grouse is a large bird that is commonly identified by its dark brown color, distinctive black belly and long, pointed tails. The Gunnison sage-grouse is nearly identical to the Greater sage-grouse and in 2000 they were officially recognized as distinct species. This bird is primarily found in sagebrush habitat and limited to seven population areas in southwestern Colorado and southeastern Utah. This species was federally listed as threatened in 2014 (79 FR 69191 69310, November 20, 2014) and was designated with critical habitat (79 FR 69311 69363, November 20, 2014)) (USFWS, 2014e).

Gunnison sage-grouse

Photo Credit: Lance Beeny

The principle threat to the Gunnison sage-grouse is sagebrush habitat loss, degradation, and fragmentation due to residential, suburban, commercial development and associated infrastructure such as roads and power lines. While sagebrush is one of the most common vegetation types in the western U.S., nearly all of it has been altered or disturbed in some way due to habitat conversion for agricultural use or urbanization, wildfire, and invasive species encroachment and treatment. Habitat degradation is further exacerbated by the fact it can take “up to 80 years” after impacts occur for sagebrush habitat to recover (USFWS, 2014e).

Least Tern. The least tern is a 9-inch long, grey, and white gull, with black markings on its head. The species was federally listed as endangered in 1985 (50 FR 21784 21792, May 28, 1985). The tern is a summer resident in Colorado and breeds along several major river systems in the U.S., which include the Missouri, Ohio, Red, and Rio Grande River. Specifically in Colorado, Adobe Creek and Nee Noshe reservoirs have been known to host breeding populations (USFWS, 1990a).

Least tern Photo Credit: USFWS

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

Lesser Prairie-Chicken. The lesser prairie-chicken is a medium-sized, grayish brown grouse of approximately 16 inches in length. The species is marked with alternating brown and white bands and have tufts of elongated feathers on each side of their neck. The lesser prairie-chicken was federally listed as threatened in 2014 (79 FR 19973 20071, April 10, 2014), although current legislation is challenging this listing (National Audubon Society, 2015b) (USFWS, 2015i).

Historically the lesser prairie-chicken was found throughout the southern plains of Texas, New Mexico, Oklahoma, Kansas and Colorado, but today, the species ranges in less than 16 percent of these grasslands (USFWS, 2014f). Locally, the species is known to occur in the great plains of southeastern Colorado. Primary threats to the species include habitat loss and fragmentation due to development, infrastructure, and land conversion, impacts from oil/gas and wind farms, transmission lines, and recent droughts where lesser prairie-chicken populations dropped by more than half. Additional factors include impacts from invasive plants, predation, and that the species becomes less resilient with greater isolation.(USFWS, 2015j)

Mexican Spotted Owl. The threatened Mexican spotted owl is characterized by its chestnut brown color, white and brown-spotted abdomen, and dark eyes. This owl species has a brown tail with thin white bands and lacks ear tufts. This species was federally listed as threatened in 1993 and in 2004, was designated with critical habitat (69 FR 53182 53298, August 31,2004) (USFWS, 2015k)

The Mexican spotted owl lives in forested mountains and canyonlands throughout central and western parts of Colorado. The two primary threats for this species include the alteration of habitat due to timber harvesting and wildland fires.(USFWS, 2012a)

Piping Plover. The piping plover is a small, migratory shorebird of approximately 7 inches in length, with a wingspan of 19 inches. It weighs approximately two ounces. The species has a grey back, white underbelly, black head markings, and neck ring. In the northern plains region, the species was listed as threatened in 1985 (50 FR 50726 50734, December 11, 1985) (USFWS, 2014g).

The piping plover may be found in Northern Great Plains, along the Atlantic Coast, and in the Great Lakes Area within the U.S. for approximately 3 to 4 months during the summer breeding season. Suitable habitat consists of open, sparsely vegetated beaches composed of sand or gravel on islands or shorelines of inland lakes or rivers; and in Colorado this bird has been noted in several counties containing these types of habitat (USFWS, 2015l). Nesting often occurs in palustrine wetlands[107] in the Northern Great Plains. Threats to piping plovers include destruction and degradation of preferred habitat resulting from construction and development activities and water control structures, nest predation, and nest abandonment caused by human presence or disturbance(USFWS, 2012b) (USFWS, 2003b).

Southwestern Willow Flycatcher. The Southwestern Willow flycatcher is a small grey-brown bird with a relatively large bill, white throat and a yellowish belly. The species is typically 6 inches in length (including the tail) and is characterized by its sharp whistles. The Southwestern Sillow flycatcher was federally listed as endangered in 1995 (60 FR 10695 10715, February 27, 1995) and in 2013, it was designated with critical habitat (78 FR 343 534 January 3, 2013) (USFWS, 2015m).

[107] Palustrine wetlands: "Palustrine wetlands include nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens." (USEPA, 2015q)

The Southwestern Willow flycatcher breeds in riparian communities associated with rivers, lakes, swamps and other wetlands. In Colorado, this species is known to occur in the southern portion of the state including shores of the Rio Grande and Conejo Rivers. Threats to flycatcher include changes in riparian vegetation, due to reduction or elimination of surface water, livestock grazing, the establishment of invasive non-native plants, and parasites from brown-headed cowbirds (*Molothrus ater*) (USFWS, 2002b).

Yellow-billed cuckoo Photo credit: USFWS

Yellow-billed Cuckoo. The yellow-billed cuckoo is approximately 12 inches in length and weighs approximately two ounces. This shy, migrant bird winters in South America and breeds in the western U.S. The species was federally listed as threatened in 2014 (79 FR 59991 60038, October 3, 2014) and designated as having critical habitat (79 FR 71373 71375) (USFWS, 2015n). Currently, the yellow-billed cuckoo is known to breed in Arizona, California, Colorado, Idaho, New Mexico, and Utah (Johnson, 2009). In Colorado, the species has critical habitat designated along the Colorado, Yampa, Gunnison, Uncompahgre, Rio Grande, and Conejos Rivers of Central Colorado (USFWS, 2015n).

Preferred habitat consists of continuous riparian habitat of cottonwood and willow trees. The yellow-billed cuckoo breeds in forested areas with significant canopy cover. 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, 2014h).

Fish

Four endangered and one threatened fish are federally listed in Colorado as summarized in Table 3.1.6-5. The bonytail chub (*Gila elegans),* Colorado pikeminnow (*Ptychocheilus Lucius),* humpback chub *(Gila cypha),* and razorback sucker (*Xyrauchen texanus***)** are found in portions of the Green and Colorado Rivers in western Colorado. The greenback cutthroat trout (*Oncorhynchus clarki stomias),* are found primarily in tributaries of the upper Arkansas River in eastern Colorado. The Arkansas darter *(Etheostoma cragini)* is a candidate species in the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Colorado is provided below.

Table 3.1.6-5: Federally Listed Fish Species of Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Bonytail Chub	*Gila elegans*	E	Yes	Portions of the Upper and Lower Colorado Rivers, the Green River, and Lake Mohave in central and western Colorado
Colorado Pikeminnow (Squawfish)	*Ptychocheilus lucius*	E	Yes	Portions of the Green River, Upper Colorado River and the San Juan River.
Greenback Cutthroat Trout	*Oncorhynchus clarki stomias*	T	No	Headwaters of the South Platte and Arkansas River drainages
Humpback Chub	*Gila cypha*	E	Yes	Portions of the Colorado, Little Colorado, Green, and Yampa rivers.
Razorback Sucker	*Xyrauchen texanus*	E	Yes	Portions of the San Juan, Gunnison, Colorado and Yampa Rivers of western Colorado

Source: (USFWS, 2015o) (USFWS, 2015p)

[a] E = Endangered, T = Threatened

Bonytail Chub. The bonytail chub is an extremely rare, long-lived fish, once prevalent in the Colorado River basin. The species has a streamlined body, concave skull, and pencil-like in appearance, growing over two feet in length. The species was federally listed as endangered in 1980, (45 FR 27710 27713, April 23, 1980) and in Colorado has critical habitat designated in the Green, Colorado, and Yampa Rivers in Saguache, Moffat, and Mesa counties (59 FR 13374 13400, March 21, 1994) (USFWS, 2002a). The bonytail chub is the rarest native fish in the Colorado River Basin and has been observed infrequently in the last decades. Historically, the fish's range was widespread and abundant throughout the Colorado River Basin in the warmer waters from Mexico to Wyoming. Today, few populations are known to exist in the upper Colorado and Green Rivers and Lake Mohave (USFWS, 2002a).

Though little is known about this rare fish, drawing upon other similar chub, it is speculated that spawning occurs in eddies during the months of June and July and that habitats required for conservation include, river channels, and flooded, ponded, or inundated river eddies and pools. Threats to the species include impacts to river hydrology which modify water temperatures, flow rates, and sedimentation of the species habitat. Since 1905, in the lower Colorado River Basin there have been more than 14 dams which impede migration, and make the variability of the genepool less diverse; and these developments have introduced non-native competition from other species. Additional threats include pesticides and pollutants, disease and predation. (USFWS, 2002a).

Colorado Pikeminnow (Squawfish). The Colorado pikeminnow (also known as the Colorado squawfish) is the largest American minnow, reaching up to 6 feet in length and weighing more than 80 pounds. The speckled, greenish fish has an elongated body, long slender head, and teeth occurring in its throat and gills rather than in its jaws (USFWS, 2014c). The pikeminnow was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 1994, the species was designated with critical habitat (59 FR 13374 13400, March 21, 1994). (USFWS, 2002a).

Historically, the species was endemic throughout the Colorado River Basin, though today, populations occur only in portions of the Green River, upper Colorado River, and a small numbers of individuals in the San Juan River. The Colorado pikeminnow migrate long distances, swimming hundreds of miles to and from spawning areas. Species habitat requirements include pools, deep runs, and eddies maintained by high spring flows. Threats to the species include streamflow regulation, habitat modification, competition with and predation by non-native fish species, and pesticides and pollutants. (USFWS, 2002a).

Greenback Cutthroat Trout. The greenback cutthroat trout is typically a rosy green with dark speckles covering the body. During spawning season, crimson red markings are apparent on the bodies and gills (USGS, 2015g). The species is known to grow to lengths of 17 inches and weighing approximately 1 to 2 pounds. The greenback cutthroat trout was initially listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 1978, the species was downlisted to threatened (43 FR 16343 16345, April 18, 1978) (USGS, 2015g). This species "inhabits cold water streams and lakes and spawn in the spring (from May to mid-July)" (USFWS, 2016).

Greenback cutthroat trout

Photo Credit: Kevin Rodgers

In Colorado, the greenback is native to the headwaters of the South Platte and Arkansas River drainages. The greenback and the Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*), represent the easternmost limits of native trout. Their numbers declined through the 19th and 20th centuries from loss of habitat caused by mining and agriculture, over-harvest, and the introduction of non-native trout species. The greenback was extirpated from most of its native range and the species was thought subspecies extinct. In 1973, 2 small populations were confirmed that represented approximately 2,000 greenbacks in approximately 3 miles of stream. Present threats include over-harvest from anglers, introduction of non-native species, and hybridization or competition with other trout species. (USFWS, 2016)

Humpback Chub. The humpback chub is a long-lived fish growing up to 15 inches with a pronounced hump from above the gills to its dorsal fin. The species is grey or olive colored on its back with silver sides, a white belly, and rosy fins during the mating season (USFWS, 2014i). The humpback chub was listed as endangered in 1967 (32 FR 4001, March 11, 1967) and was incorporated into the ESA as an endangered species (16 U.S.C. §1531 et seq.). In 1994, the species was designated with critical habitat (59 FR 13374 13400, March 21, 1994) along the Gunnison and Yampa rivers of western Colorado (USFWS, 2015d).

Historically, the humpback chub was endemic to the Colorado River basin, though today populations are restricted to the Colorado, Little Colorado, Green, and Yampa Rivers. The largest population is located in the Little Colorado River of the Grand Canyon. Factors such as stream alteration (e.g., dams, irrigation, dewatering, and channelization), competition with, and predation by non-native fish species, and hybridization with other chub may have led to the decline of the humpback chub (USFWS, 1990b).

Razorback Sucker. The razorback sucker is a long slender fish growing up to approximately 40 inches in length and weighing up to 12 pounds. The species is marked with dark head and dorsal fins with a yellowish white underbelly and caudal fins (USFWS, 2002c). The razorback sucker was federally listed as endangered in 1991 (56 FR 54957 54967, October 23, 1991) and was given designated critical habitat in 1994 (59 FR 13374 13400, March 21, 1994) in the San Juan, Gunnison, Colorado and Yampa Rivers of western Colorado (USFWS, 2015d).

Historically, razorback sucker were widely distributed in warm-water reaches of larger rivers of the Colorado River Basin from Mexico to Wyoming. Typical habitat includes features such as "deep runs, eddies, backwaters, and flooded environments in spring; runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter. Spawning in rivers occurs over bars of cobble, gravel, and sand substrates during spring runoff at widely ranging flows and water temperatures" (USFWS, 2002c). Threats to the species include changes in streamflow, habitat, and introduction of competitive or predatory non-native fish species, and pesticides and pollutants.

Invertebrates

One endangered and one threatened invertebrate are federally listed in Colorado as summarized in Table 3.1.6-6. The Pawnee montane skipper (*Hesperia leonardus montana)* can be found in or along rivers of central Colorado, and the Uncompahgre fritillary butterfly (*Boloria acrocnema)* in known to occur in the Rocky Mountains of central Colorado. The Arapahoe snowfly (*Capnia Arapahoe*) is a candidate species in the state. Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Colorado is provided below.

Table 3.1.6-6: Federally Listed Invertebrate Species of Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Pawnee Montane Skipper	*Hesperia leonardus montana*	T	No	Within the South Platte River drainage system of Jefferson, Douglas, Teller, and Park Counties
Uncompahgre Fritillary Butterfly	*Boloria acrocnema*	E	No	Above treeline on north and east facing slopes of central Colorado

Source: (USFWS, 2015o) (USFWS, 2015p)

[a] E = Endangered, T = Threatened

Pawnee Montane Skipper. "The Pawnee montane skipper is a small, brownish-yellow butterfly with a wing span slightly over one inch" (USFWS, 1998) Small, brownish-yellow and white spots distinguish the wings (USFWS, 1998). The species was listed as threatened in 1987 (52 FR 36176 36180, September 25, 1987). It may be found in dry ponderosa pine woodlands at elevations greater than 6,000 feet from late summer until the first frost. The ponderosa pine understory is limited, but key support species include blue grama grass (*Bouteloua gracilis*), a larval food plant, and the prairie gayfeather (*Liatris punctate*), the primary nectar plant (USFWS, 1998).

The skipper occurs only on the Pikes Peak Granite Formation in the South Platte River drainage system in Colorado, in portions of Jefferson, Douglas, Teller, El Paso, and Park Counties. Threats to the species include habitat loss through reservoir development of the South Platte drainage, habitat fragmentation, invasive species outcompeting the blue grama grass, pesticide use, and climate change. (USFWS, 1998)

Uncompahgre Fritillary Butterfly. The Uncompahgre fritillary is a small, brown butterfly with black, white, crimson, and purple markings and a one-inch wingspan. The Uncompahgre fritillary butterfly was discovered in 1978 on Uncompahgre Peak of Hinsdale County, Colorado. The species was federally listed as endangered in 1991 (56 FR 28712 28717, June 24, 1991). The butterfly is found above the tree line in groves of snow willow (*Salix reticulate*) on north- and east-facing slopes of central Colorado (USFWS, 2015p).

Threats to the species have included butterfly collecting, disease, predation, trampling of larvae by humans and livestock, and habitat degradation from hiking trails; though presently the largest threat is climate change, which may affect the lifecycle and disrupt the Uncompahgre fritillary butterfly’s larval development (USFWS, 1994).

Plants

Seven endangered and nine threatened plant species are federally listed and known to occur in the state of Colorado as summarized in Table 3.1.6-7. The 16 plant species listed all have different ranges throughout the state of Colorado that range from the grasslands and prairies of eastern Colorado to the Rocky Mountains in the northern and central parts of the state, to barren desert and shale outcroppings of the Four Corners region. Two candidate species are identified in the state, the Chapin Mesa milkvetch (*Astragalus schmolliae*) and skiff milkvetch (*Astragalus microcymbus*). Information on the habitat, distribution, and threats to the survival and recovery of each of these species in Colorado is provided below.

Table 3.1.6-7: Federally Listed Plant Species of Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Clay-loving Wild Buckwheat	*Eriogonum pelinophilum*	E	Yes	Clay hills near Delta and Montrose, Colorado
Colorado Butterfly Plant	*Gaura neomexicana* var. *coloradensis*	T	No	Stream channels and wetlands or among grasses of the high plains of northern Colorado

Common Name	Scientific Name	Federal Status [a]	Critical Habitat in Colorado	Habitat Description
Colorado Hookless Cactus	*Sclerocactus glaucus*	T	No	Rocky areas along the Colorado and Gunnison Rivers in Delta, Montrose, Mesa, and Garfield Counties, Colorado
DeBeque Phacelia	*Phacelia submutica*	T	Yes	Expansive clay soils on steep slopes and ridge tops of Mesa and Garfield Counties
Dudley Bluffs Bladderpod	*Lesquerella congesta*	T	No	Shale soils of Piceance Creek in Rio Blanco County
Dudley Bluffs Twinpod	*Physaria obcordata*	T	No	Shale slopes of the Piceance Creek area in Rio Blanco County in western Colorado
Knowlton's Cactus	*Pediocactus knowltonii*	E	No	Woodlands, sage brush flats, and desert grasslands of south western Colorado
Mancos Milkvetch	*Astragalus humillimus*	E	No	Scattered areas between Towaoc, Colorado and the Chaco River
Mesa Verde Cactus	*Sclerocactus mesae-verdae*	T	No	Gypsum clay deserts of southwestern Colorado
North Park Phacelia	*Phacelia formosula*	E	No	Specific barren outcroppings near North Park, Colorado
Osterhout Milkvetch	*Astragalus osterhoutii*	E	No	Specific barren shale soils near Kremmling, Colorado
Pagosa Skyrocket	*Ipomopsis polyantha*	E	Yes	Grasslands on Mancos Shale soils near Pagosa Springs, Colorado
Parachute Beardtongue	*Penstemon debilis*	T	Yes	Steep, unstable shale slopes near Parachute, Colorado
Penland Alpine Fen Mustard	*Eutrema penlandii*	T	No	Alpine meadows at elevations above 11,800 feet in the Mosquito Range
Penland Beardtongue	*Penstemon penlandii*	E	No	Barren shale soil exposures near Kremmling, Colorado
Ute Ladies' Tresses	*Spiranthes diluvialis*	T	No	Wetlands, meadows, and swales[108] of central and northwestern Colorado

Source: (USFWS, 2015o) (USFWS, 2015p)

[a] E = Endangered, T = Threatened

Clay-loving Wild Buckwheat. Clay-loving wild buckwheat (*Eriogonum pelinophilum)* is a low-growing shrub with dark green needle-like leaves. It grows between 6 to 8 inches tall and lives approximately 20 to 50 years. Small, white flowers bloom from late May to early September. The species was listed as endangered in 1984 (49 FR 28562 28565, July 13, 1984) and was designated as having critical habitat in 2009 (74 FR 49835 49842, September 29, 2009) (USFWS, 2009). (USFWS, 2015r) (USFWS, 1988)

The clay-loving wild buckwheat is endemic to the clay hills near Delta and Montrose, Colorado. The white alkaline clay there is derived from the Mancos Shale Formation, deposits from an ancient inland sea. The unique soils that support clay-loving wild buckwheat populations are limited in their distribution. Threats to the species include high risk of habitat loss from urban,

[108] Swale: "A swale, sometimes called a biofilter, is a grass-lined channel that is designed to convey storm water in shallow flow. Pollutant removal is accomplished through filtration through the vegetation and swales are frequently designed to allow for infiltration of storm water." (USEPA, 2015p)

residential, and agricultural development in the region, off-road vehicle impacts, and indirect negative affects to the species from changes in pollinator communities, habitat, hydrology, and fragmentation of populations. (USFWS, 2015r) (USFWS, 1988)

Colorado Butterfly Plant. The Colorado butterfly plant *(Gaura neomexicana* var. *coloradensis)* is a perennial, flowering plant and a member of the evening primrose family. The plant grows to approximately 2 feet tall and has white, ½ inch, four-petal flowers with leaves of 2 to 6 inches in length. It was federally listed as threatened in 2000 (65 FR 62302 62310 October 18, 2000) and critical habitat was designated for this species within the state of Wyoming in 2004 (69 FR 47834 47862 August 6, 2004) (USFWS, 2004) (USFWS, 2011)

Although the historic range of the Colorado butterfly plant is unknown, it is typically found along stream channels and wetlands or among grasses of the high plains. Today, the species occurs in southeastern Wyoming, north-central Colorado, and western Nebraska. Within Colorado, the butterfly plant may be found on ranches, natural areas, and preserves in Larimer, Boulder, Broomfield, Douglas, Jefferson, and Weld counties (USFWS, 2010a). Threats to the species include ecological succession and overgrowth of vegetation. The Colorado butterfly plant grows in open and disturbed areas historically maintained by flooding and fire. Today, grazing is an important component of maintaining disturbed grasslands and Colorado butterfly plant habitat (USFWS, 2015d).

Colorado Hookless Cactus. The Colorado hookless cactus *(Sclerocactus glaucus)* is a barrel-shaped cactus that grows up to 12 inches tall. The cactus produces pink to violet, funnel-shaped flowers approximately 2 inches in diameter. The species was listed as threatened in 1979 (44 FR 58868 58870, October 11, 1979), and was reclassified into three distinct species in 2009 (74 FR 47112 47117 September 15, 2009) (USFWS, 2015o).

In Colorado, the Colorado hookless cactus grows on rocky surfaces of southern facing areas along the Colorado and Gunnison Rivers in Delta, Montrose, Mesa, and Garfield Counties. Ongoing and foreseeable threats to the species include mineral and energy development, illegal collection, recreational off-road vehicle use, grazing, invasive species, water reservoir projects, predation, the impact of herbicides and pesticides upon pollinators, and climate change (USFWS, 2010b).

DeBeque Phacelia. The DeBeque phacelia *(Phacelia submutica)* is a low-growing, annual plant with red hairy stems and leaves, yellow tube shaped flowers, and a tap root. The species was federally listed as threatened in 2011 (76 FR 45054 45075, July 27, 2011) and had critical habitat designated in 2012 (77 FR 48367 48418, August 13, 2012) (USFWS, 2015o).

The Debeque phacelia grows in expansive clay soils on steep slopes and ridge tops of Mesa and Garfield Counties, Colorado. The species grows in a habitat with wide temperature fluctuations, long drought periods, and erosive saline soils. Upon drying, cracks form in the shrink-swell clay soils. Seeds from the phacelia are deposited into cracks which then close again during moist cycles, covering the seeds. Seeds can remain dormant for five years until the combination and timing of temperature and precipitation are right for germination. Threats to the DeBeque phacelia are associated with natural gas exploration and production and the associated expansion of pipelines, roads, and utilities; development within the West-wide Energy Corridor; increased access to the habitat by off-highway vehicles; and soil and seed disturbance by livestock. (USFWS, 2015d)

Dudley Bluffs Bladderpod. Dudley Bluffs bladderpod *(Lesquerella congesta)* is an extremely small plant growing up to 1.2 inches in diameter with small silvery leaves and a large woody taproot. The bladderpod blooms bright yellow flowers in the spring and has seeds contained in small air-filled sacs. The species was federally listed as threatened in 1990 (55 FR 4152 4157, February 6, 1990) (USFWS, 2015o).

Dudley Bluffs bladderpod

Photo Credit: USFWS

The Dudley Bluffs bladderpod is only known to occur in the Piceance Creek area of Rio Blanco County, in western Colorado. Its known habitat is level surfaces of the Green River Formation. Shale outcrops in the region have little soil development and are very harsh environments for plant growth; so only plants well adapted to survive in these conditions may thrive. This region is also part of the Piceance Basin's multi-mineral oil shale zone, an area containing large reserves of oil shale, natural gas, and minerals. Energy exploration, extraction, and the many associated activities in the region can disturb or degrade the fragile shale habitats. They can also pose a threat to native ground nesting bees that pollinate Dudley Bluffs bladderpod. Others threats include weed invasion and increased access to these remote areas by recreationists. (USFWS, 1993)

Dudley Bluffs Twinpod. Dudley Bluffs twinpod *(Physaria obcordata*) is a compact plant growing 4 to 7 inches tall and approximately 7 inches in diameter with smooth, narrow, arrowhead-shaped leaves. The twinpod blooms clusters of small, bright yellow flowers during a short window between mid-May and June each year. The species was federally listed as threatened in 1990 (55 FR 4152 4157, February 6, 1990) (USFWS, 2015o).

The Dudley Bluffs twinpod is only known to occur in the Piceance Creek area of Rio Blanco County, in western Colorado. Its known habitat is slopes of the Green River Formation. These shale outcrops have little soil development and are very harsh environments for plant growth; so only plants well adapted to survive in these conditions may thrive. This region is also part of the Piceance Basin's multi-mineral oil shale zone, an area containing large reserves of oil shale, natural gas, and minerals. Energy exploration, extraction, and the many associated activities in the region can disturb or degrade the fragile shale habitats. They can also pose a threat to native ground nesting bees that pollinate Dudley Bluffs twinpod. Others threats include weed invasion and increased access to these remote areas by recreationists. (USFWS, 1993)

Knowlton's Cactus. The Knowlton's cactus *(Pediocactus knowltonii)* is an extremely rare cactus first discovered in Colorado in 1958. The species has cylindrical stems growing as tall as

2 inches with pink flowers approximately 1 inch in diameter. It was listed as endangered in 1979 (44 FR 62244 62246, October 29, 1979) (USDA, 2007).

The Knowlton's cactus is typically found in juniper woodlands, sage brush flats, and desert grasslands of northwestern New Mexico and southwestern Colorado. Threats to the species include illegal harvesting by commercial vendors and private collectors, energy and utility corridor development, and rodent or rabbit predation (USFWS, 2010c).

Mancos Milkvetch. The Mancos milkvetch *(Astragalus humillimus)* is a small, low-growing, tufted perennial shrub that grows in clumps up to 12 inches across with a dense crown of spiny leaf stalks. Leaves are 1.6 inches long and composed of crowded small rounded leaflets. Flowers are lavender and approximately 0.5 inches in length. The species was listed as threatened in 1985 (50 FR 26568 26572, June 27, 1985) and is only known to be found in northwestern New Mexico and southwestern Colorado (USFWS, 2015o).

Mancos milkvetch occurs in scattered populations between the town of Towaoc, Colorado, and the Chaco River of New Mexico. "All but one site occur at least primarily on lands of the Navajo Nation and the Ute Mountain Ute Tribe. The remaining site and portions of other sites occur on New Mexico State Trust land or land administered by the Bureau of Land Management" (USFWS, 2015o). Threats to the species include impact to its habitat from mineral or energy development of the San Juan Basin, or human collection of the plant (USFWS, 1989).

Mesa Verde Cactus. The Mesa Verde cactus *(Sclerocactus mesae-verdae)* is a smaller cactus with a stem of up to 3 inches tall. The plant blossoms tan and yellow flowers which split open and fruit black seeds. It has the ability to retract into the soil in periods of extended drought and is similar in many ways to the Wright fishhook cactus (*Sclerocactus wrightiae*) (USFWS, 1984). The Mesa Verde cactus was listed as threatened in 1979 (44 FR 62471 62474, October 30, 1979), and located in northwestern New Mexico and southwestern Colorado.

One Colorado population is found on the Ute Mountain Indian Reservation and populations in New Mexico are found on the Navajo Indian Reservation, BLM lands, and other private desert parcels with high alkaline, gypsum clays. Threats to the species include collection by cactus enthusiasts, habitat destruction, and isolated populations. (USFWS, 1984)

North Park Phacelia. North Park phacelia *(Phacelia formosula)* is a shrub growing up to 12 inches tall with bright purple flowers and dark green leaves. The North Park phacelia blooms in July and August bi-annually before dying. North Park phacelia was discovered in 1918 and listed as endangered in 1982 (47 FR 38540 38543, September 1, 1982). (USFWS, 2015o))

The North Park phacelia is found only in North Park located in northern Colorado's Jackson and Larimer Counties. The species is limited to barren outcrops and found around 8,000 feet in elevation. The primary threats to North Park phacelia include trampling, off-highway vehicle recreation, land use changes including energy development, and commercial and residential development. Insects pollinate the species and are necessary to maintain its genetic diversity, and threats which impact local pollinators are also considered threats to the North Park phacelia. (USFWS, 2015o)

Osterhout Milkvetch. The Osterhout milkvetch *(Astragalus osterhoutii)*, also known as the Kremmling Osterhout milkvetch, is a member of the pea family and has stalks which grow up to 40 inches tall with small white flowers and long maroon pods. The species was discovered in 1905 and listed as endangered in 1989 (54 FR 29658 29663, July 13, 1989). The Osterhout milkvetch may only be found within a 15-mile radius near the town of Kremmling in Middle Park (located in northern Colorado), where five populations are found scattered on barren shale soils. "These soils are rich in selenium, which the Kremmling Osterhout milkvetch concentrates in its tissues— giving the plants a distinctive garlic-like odor" (USFWS, 2015s).

Threats to the Osterhout milkvetch include off-highway vehicle recreation, road and utility construction and maintenance, mining, oil and gas exploration, concentrated livestock use, land development, climate change, and non-native invasive plants (USFWS, 1992).

Pagosa Skyrocket. Pagosa skyrocket *(Ipomopsis polyantha)* grows 12 to 24 inches tall with clusters of white or light pink flowers in bloom between June and July. The plant grows as a rosette for years until conditions are right to flower and reproduce. The species was listed as endangered in 2011 (76 FR 45054 4507, July 27, 2011), with critical habitat first designated on forest service lands in 2012 (77 FR 18157 18172, March 27, 2012). (USFWS, 2015t)

The Pagosa skyrocket grows in two populations near the town of Pagosa Springs at an elevation of approximately 7,000 feet. While the plant is typically found in grasslands on Mancos Shale soils and at the edges of open forests, the Pagosa skyrocket is also found adjacent to disturbed areas such as dry ditches, among buildings, and in pastures. Threats to the species include land use changes, property development, utility installations, non-native invasive plants, trampling from livestock, threats to pollinators and climate change (USFWS, 2013c).

Parachute Beardtongue. Parachute beardtongue *(Penstemon debilis)* is a perennial plant with thick, succulent, bluish leaves, underground shoots, and small, lavender, funnel-shaped flowers. The species was listed as threatened and designated with critical habitat in 2011 (76 FR 45054 45075; 76 FR 45078 45128 July 27, 2011). Parachute beardtongue grows on steep, oil shale outcrop slopes above the Colorado River near the town of Parachute, Colorado. Historic distribution for this species is not known and current species are found within 92 acres of Garfield County, Colorado. (USFWS, 2015u)

Parachute beardtongue plants survive on steep, unstable slopes by extending shoots as the plant becomes buried by the shifting talus. They produce a small number of seeds that are dispersed by gravity. This plant requires cross pollination, and depends on a number of different common pollinators such as bee and butterfly. The species is threatened primarily by oil and gas development, its limited range, and small population size. (USFWS, 2015u)

Penland Alpine Fen Mustard. Penland alpine fen mustard *(Eutrema penlandii)*, also known as Mosquito Range mustard, is a small perennial plant with clusters of white, four-petaled flowers. The species was first discovered in 1935 and was listed as threatened in 1993 (58 FR 40539 40547, July 28, 1993). This species is only found in alpine meadows at elevations above 11,800 feet in the Mosquito Range of the Rocky Mountains, in central Colorado. (USFWS, 2015v)

Penland alpine fen mustard is often rooted in moist tufts of mosses or hidden among short-bladed grasses. Threats to the species include local changes to hydrology, recreation activities such as off-road vehicle use, camping, and hiking, land development, mining, and the effects of climate change (USFWS, 2015v).

Penland Beardtongue. The Penland beardtongue *(Penstemon penlandii)*, also known as the Kremmling beardtongue, is a shrub in the plantain family which grows up to 6 inches tall, 8 inches wide and has a spreading root system with dark green, rolled leaves. It has blue-violet, tubular flowers of approximately 0.75 inches long. The Penland beardtongue was listed as endangered in 1989 (54 FR 29658 29663, July 13, 1989) and is endemic to Middle Park in Grand County, near the town of Kremmling, Colorado. Middle Park is a mountain valley at approximately 7,500 feet in elevation and is home to the remaining known population of Penland beardtongue. (USFWS, 2015w)

The species thrives on barren shale soil making it exposed to off-highway vehicle recreation. Additional threats include fugitive dust from nearby roads, impacts associated with utility maintenance, climate change, and non-native invasive plants. Protection of native bee pollinators and their nesting habitat is also essential to the Penland beardtongue. (USFWS, 2015w)

Ute Ladies' Tresses. The Ute ladies'tresses *(Spiranthes diluvialis)* is a perennial orchid that grows up to 24 inches in height and that typically flowers from early August to early September. The Ute ladies' tresses was federally listed as threatened in 1992 (57 FR 2048 205, January 17, 1992) and was proposed to be delisted in 2004 (USFWS, 2015x). Though the species is recovering, its threatened status is current.

The species occurs throughout Colorado, Idaho, Montana, Nebraska, Nevada, Utah, Washington, and Wyoming. Within Colorado, the species is believed to grow in wetlands, meadows, and swales[109] of central and northwestern regions of the state. Threats to this species include urbanization, agriculture, recreation, grazing, and invasive non-native species. (USFWS, 1995)

3.1.7. Land Use, Recreation, and Airspace

3.1.7.1. Definition of the Resource

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

Land Use, Recreation, and Airspace

Land use is defined as "the arrangements, activities, and inputs people undertake in a certain land cover type to produce, change, or maintain it" (Di Gregorio & Jansen, 1998). A land use designation can include one or more pieces of land, and multiple land uses may occur on the

[109] Swale: "A swale, sometimes called a biofilter, is a grass-lined channel that is designed to convey storm water in shallow flow. Pollutant removal is accomplished through filtration through the vegetation and swales are frequently designed to allow for infiltration of storm water." (USEPA, 2015p)

same piece of land. Land use also includes the physical cover, observed on the ground or remote sensing and mapping, on the earth's surface; land cover includes vegetation and man-made development (USGS, 2012a).

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

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

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, 2015). Airspace is a finite resource that can be defined vertically and horizontally, as well as temporally, when discussing it in relation to aircraft activities. Airspace management addresses how and in what airspace aircraft fly. Air flight safety considers aircraft flight risks, such as aircraft mishaps and bird/animal-aircraft strikes. The Federal Aviation Administration (FAA) is charged with the safe and efficient use of the nation's airspace and has established criteria and limits to its use.

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

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

3.1.7.2. Specific Regulatory Considerations

Land use planning in Colorado is the primary responsibility of local governments (i.e., county). The main planning tools for local governments include the comprehensive plan, zoning ordinance, and subdivision ordinance. The land use code for each county sets forth the authority for each of these tools, as granted to the counties by state-enabling legislation. The comprehensive plan projects long-term population growth, and proposes land uses, and locations of public facilities and utilities. The zoning ordinance sets forth the rules used to govern the land by dividing localities into zoning districts and establishes allowable uses within the districts (e.g., agriculture, industry, commercial use). The subdivision ordinance manages the process for dividing large land parcels into smaller lots (Colorado Department of Local Affairs, 2008).

Because the nation's airspace is governed by federal laws, there are no specific Colorado state laws that would alter the existing conditions relating to airspace for this PEIS.

3.1.7.3. Land Use and Ownership

For the purposes of this analysis, Colorado is classified into primary land use groups based on coverage type as forest and woodlands, agricultural, developed land, and public land/surface water/other land covers. Land ownership within Colorado is classified into four main categories: private, federal, state, and tribal land.

Land Use

Table 3.1.7-1 identifies the major land uses by coverage type in Colorado. Forest and woodlands comprise the largest portion of land use, with 31 percent of the land area in Colorado occupied by this category. Agriculture is the second largest area of land use, with 20 percent of the total land area. Developed areas account for approximately one percent of the total land area in Colorado. The remaining percentage of land includes public land, surface water, and other land cover, shown in Figure 3.1.7-1, that are not associated with specific land uses (USGS, 2012b).

Table 3.1.7-1: Major Land Use in Colorado by Coverage Type

Land Use	Square Miles[a]	Percent of Land
Forest and Woodland	32,166	31%
Agricultural Land	20,373	20%
Developed Land	1,225	1%
Public Land, Surface Water, and other Land Cover	49,878	48%
Total	**103,642**	**100%**

[a] Square miles are rounded to the nearest whole number. The maps and tables are prepared from the analysis of GIS data and imagery; a margin of error may result 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. Other federal or state data sources may have slightly different totals.

Source: (USGS, 2011)

Forest and Woodland

Forest and woodland areas can be found throughout the state, many of them interspersed with, and adjacent to, agricultural areas. The largest concentrations of forest are located throughout the western portion of the state within the Rocky Mountain geographic region (Figure 3.1.7-1). Most forest and woodland areas throughout Colorado are in federal ownership (approximately 68 percent), and approximately 30 percent of Colorado’s forests are privately owned. The remaining areas of forestland is owned and managed by tribal governments, state agencies, and other entities and municipalities (CSFS, 2015a).

National Forests

National forests in Colorado comprise approximately 68 percent of the state’s total forestland, and includes 12 National Forests: Roosevelt, Arapahoe, White River, Pike, San Isabel, Grand Mesa, Gunnison, Uncompahgre, Rio Grande, San Juan, Manti-La Sal, and Routt National Forests (USFS, 2013) (USGS, 2011). These National Forests occur throughout the western half of the state, covering 15,118 square miles (USGS, 2011). The forests are managed for multiple uses and values, including recreation activities (e.g., camping, hiking), timber production, and maintenance of fish and wildlife habitat (USFS, 2016a).

The approximate breakdown of federal forest and woodland ownership/management in Colorado is as follows:

- USFS (47 percent),
- Bureau of Land Management (BLM) (17 percent), and
- National Park Service (NPS) (2 percent) (USGS, 2011).

Section 3.1.6, Biological Resources, presents additional information about Colorado's terrestrial vegetation.

State Forests

Colorado has one state forest, the “Colorado State Forest”, which is a 71,000-acre state trust property managed for multiple uses and values, including general recreation (e.g., hiking, wildlife viewing) and wildlife habitat. The state forest’s recreational uses are administered by Colorado Parks and Wildlife (CPW), which leases the area for public recreation from the Colorado Board of Land Commissioners. The Colorado State Forest is located in north central Colorado, stretching almost 28 miles along the north and south of the Medicine Bow Mountains. The area's elevations range from 8,000 to 12,900 feet, and approximately 52,000 acres are forested. (CSFS, 2015b).

Private Forest and Woodland

Approximately 11,094 square miles, or 30 percent of Colorado’s total forestland, is owned by approximately 186,000 private landowners (CSFS, 2015a). Private forestlands indirectly provide some public benefit, including forest products, wildlife habitat, scenic beauty, and outdoor recreation opportunities. Scattered throughout the state, forests and woodlands on private lands often border agricultural fields, suburban neighborhoods, and national forests.

Agricultural Land

Agricultural land exists throughout the state on 20,373 square miles, or 20 percent of Colorado's total land area (Figure 3.1.7-1) (USGS, 2011). Approximately 36,180 farms exist in Colorado, with an average size of 1.4 square miles (USDA, 2012a). Colorado's top agricultural products are cattle and calves (56 percent of total agricultural receipts); grains, oilseeds, beans, and peas (19 percent of total agricultural receipts); milk from cows (7.2 percent of total agricultural receipts); and other crops and hay (5 percent of total agricultural receipts) (USDA, 2012b).

Developed Land

Developed land in Colorado is concentrated within major metropolitan areas and surrounding cities, towns, and suburbs. Although only one percent of Colorado land is developed, these areas are highly utilized for residential, commercial, industrial, recreational, and government purposes. Table 3.1.7-2 lists the top five developed metropolitan areas within the state and their associated population totals. (Colorado's total population was estimated in 2015 to be 5,456,574) (U.S. Census Bureau, 2016)

Table 3.1.7-2: Top Five Developed Metropolitan Areas

Metropolitan Area	Population Estimate
Denver/Aurora	1,016,970
Colorado Springs	445,830
Fort Collins	156,480
Pueblo	108,423
Grand Junction	60,210
Total Estimated Population of Top Metropolitan Areas	**1,787,913**
Total State Estimated Population (2015)	**5,456,574**

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

Land Ownership

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

Private Land

The majority of land in Colorado is privately owned, with most of this land falling under the land use categories of agricultural, forest and woodland, and developed (Figure 3.1.7-1). Highly developed, urban, metropolitan areas transition into suburban, agriculture, shrub, and woodland areas, which then transition into more wild and remote areas. The majority of private land exists in the eastern portion of the state.[110] (USGS, 2011)

Federal Land

The U.S. federal government manages 37,721 square miles (approximately 36 percent) of Colorado lands, with a variety of land types and uses. (USGS, 2014e). Seven federal agencies manage federal lands throughout the state (Table 3.1.7-3 and Figure 3.1.7-2).[111] There may be other federal lands, but they are not shown on the map due to their small size relative to the entire state

Table 3.1.7-3: Federal Land in Colorado

Agency	Square Miles	Representative Type
USFS	22,543	Forests, Grasslands, and Wilderness Areas
BLM	13,022	Forests, National Monuments, Wilderness Areas, Grazing Lands,
USFWS	262	Wildlife Refuges and Wilderness Areas
Bureau of Reclamation	47	Reservoirs
Department of Defense (including USACE)	786	Military Installations, Medical Centers, Training Areas, Recreation Areas, Reservoirs
NPS[112]	1,038	National Parks & Monuments, Wilderness Areas
USDA Agricultural Research Service	23	Research Areas
Total	**37,721**	

Source: (USGS, 2012c)

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

- The USFS manages 22,543 square miles of land comprised primarily of 12 National Forests (see National Forests above), the Comanche and Pawnee National Grasslands, and the Arapaho National Recreation Area (USGS, 2014e).
- The BLM manages 13,022 square miles of public land including Browns Canyon National Monument, Canyon of the Ancients National Monument, Dominguez-Escalante, Gunnison Gorge, and McInnis Canyons National Conservation Areas, and lands utilized for grazing, wild horse/burro management, mineral extraction, energy development, and recreation. (USGS, 2014e). (BLM, 2016)

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

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

[112] Additional trails and corridors pass through Colorado that are part of the National Park System.

- The USFWS manages over 100 square miles of land comprised of the Leadville National Fish Hatchery and six National Wildlife Refuges: Arapaho, Rocky Mountain Arsenal, Rocky Flats, Browns Park, Alamosa/Monte Vista/Baca, and Two Ponds National Wildlife Refuges (USGS, 2014e).
- The Bureau of Reclamation manages 47 square miles of reservoirs located throughout the state (USGS, 2012c)
- The Department of Defense manages 786 square miles of land comprised of the Naval Oil Shale Reserve, Fort Carson Army Installation, Pueblo Chemical Depot, U.S. Air Force Academy, Peterson Air Force Base, Schriever Air Force Base, Cheyenne Mountain Air Force Station, Buckley Air Force Base, Fitzsimons Army Medical Center, and John Martin and Cherry Creek Reservoirs (USGS, 2014e).
- The NPS manages 13 NPS units in Colorado, which include: 3 National Parks (Rocky Mountain, Black Canyon of the Gunnison, and Mesa Verde National Parks), 5 National Monuments (Florissant Fossil Beds, Colorado, Dinosaur, Yucca House, and Hovenweep National Monuments), 1 National Park and Reserve (Great Sand Dunes); and 1 National Recreation Area (Curecanti National Recreation Area) (USGS, 2014e).
- The USDA Agricultural Research Service manages 23 square miles of land comprised of a research station and agricultural research areas (USGS, 2014e).

State Land[113]

The state of Colorado owns and manages approximately 5,052 square miles of land, or 5 percent of the total land in the state. Nearly all of these state-administered lands are managed by the Colorado State Land Board as State Trust Lands. These lands were endowed to Colorado in 1876 by the federal government. State Trust Lands are mostly closed to public use, and leased to public/private entities. Revenues from those leases are specifically used to financially support Colorado public schools and universities and state parks. Some trust land is also leased to Colorado Parks and Wildlife and is open to the public for wildlife-related recreation (e.g., wildlife viewing, fishing, hunting, camping) (CDNR, 2015). There are 42 state parks and approximately 350 state wildlife area lands in Colorado, managed by Colorado Parks and Wildlife (CPW) (CPW, 2016e).

[113] 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.

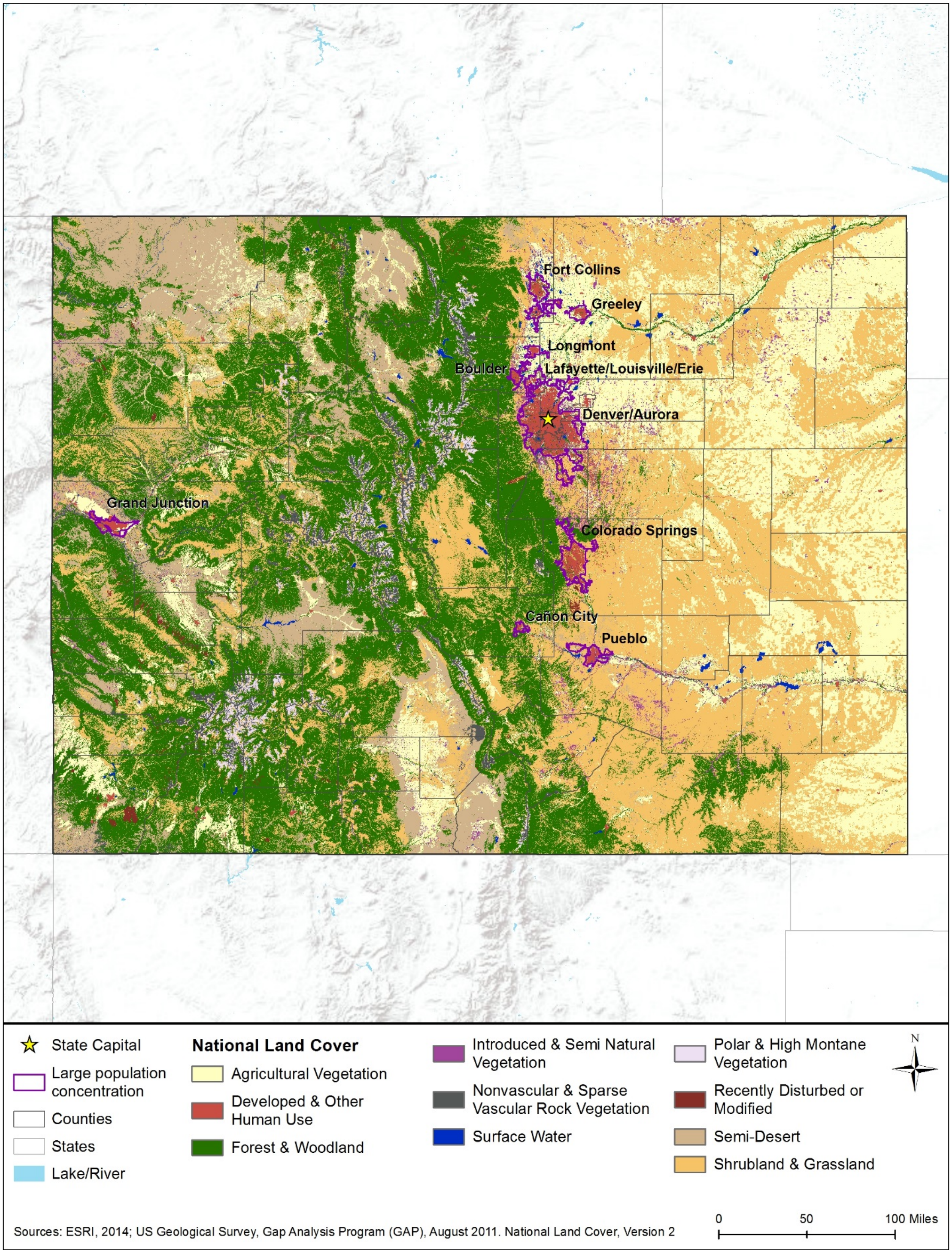

Figure 3.1.7-1: Major Land Use Distribution by Coverage Type

Tribal Land

Approximately 1,781 square miles of land in Colorado is managed by five American Indian tribes. Included in this land are two Indian Reservations held in trust by the Bureau of Indian Affairs (Figure 3.1.7-2 and Table 3.1.7-4) (USGS, 2012c).[114]

Table 3.1.7-4: Indian Reservations and Other Land Holdings in Colorado

Reservation or Tribe Name	Square Miles
Southern Ute Reservation	1,063
Ute Mountain Ute Reservation	717
Navajo	1
Uintah and Ouray	0.07
Jicarilla Apache	0.08
Total	**1,781.15**

Source: (USGS, 2012c)

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

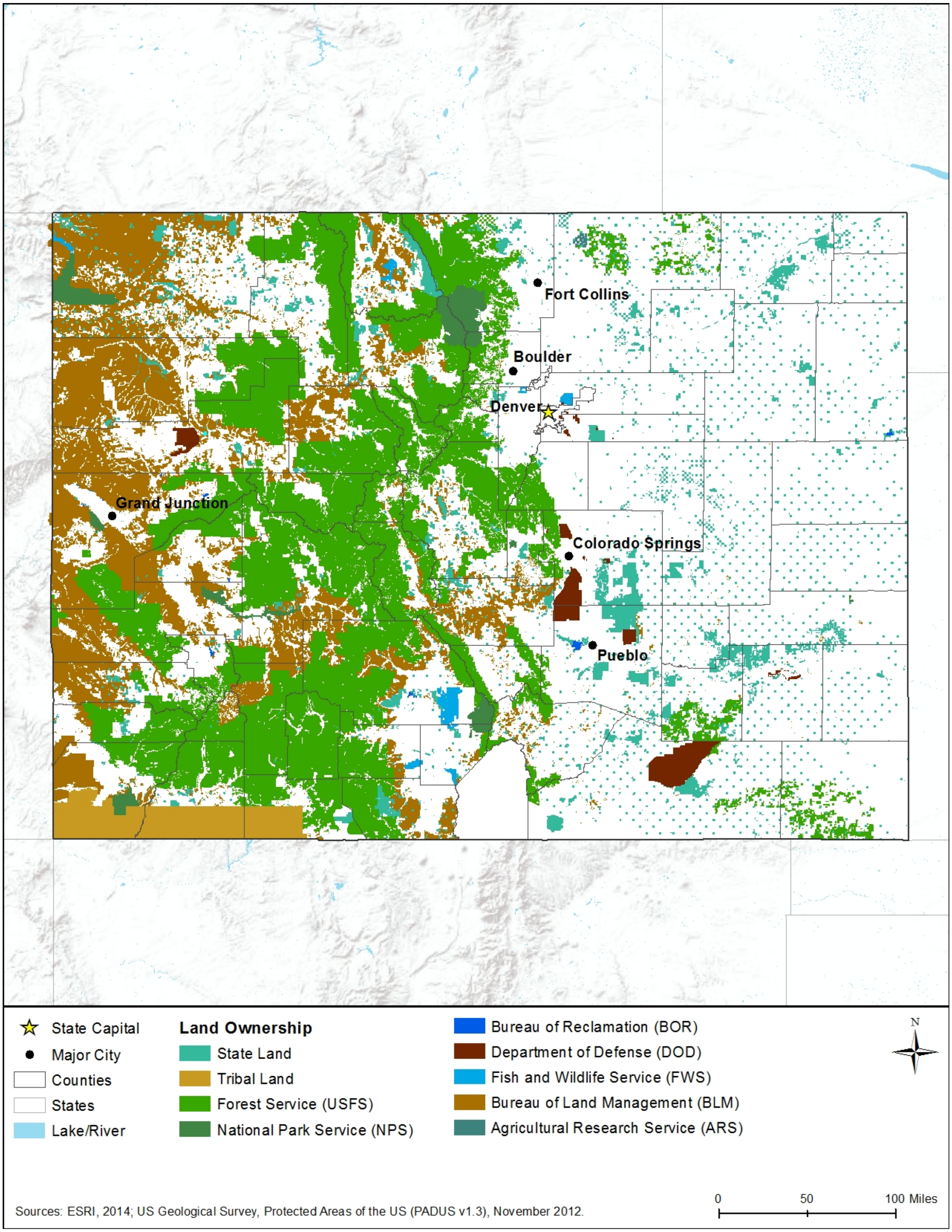

Figure 3.1.7-2: Land Ownership Distribution

3.1.7.4. Recreation

Colorado is a diverse state. The Rocky Mountains encompass the western portion of the state, the remainder of the state is mesas, deserts, and plains. The state's main population centers are along the eastern edge of the Rocky Mountains, while the rest of the state is sparsely populated or unpopulated. On the community level, towns, cities, and counties provide an assortment of indoor and outdoor recreational facilities, including athletic fields and courts, playgrounds, picnicking areas, and lake or river access points. Availability of community-level facilities is typically commensurate to the population's needs.

This section discusses recreation, calling out specific areas representative of recreational opportunities in Colorado. For information on visual aspects, see Section 3.1.8, Visual Resources, and for information on the historical significance of locations, see Section 3.1.11, Cultural Resources.

Northwest Region

The White River National Forest, the most visited forest in the United States, is dominant in this region (see Figure 3.1.7-3).[115] It contains ski resorts, wilderness areas, rivers, reservoirs, hot springs, and over 2,500 miles of trails. Among the 12 downhill skiing and snowboarding areas are the renowned Aspen Mountain Ski Area and Vail Ski Resort/Vail Pass Winter Recreation Area. Other recreational activities within the forest include: hiking, bicycling, horseback riding, and other trail use; camping and picnicking; ice, lake, and river fishing, boating, swimming, waterskiing, windsurfing, and other water activities; and licensed, seasonal hunting of big game, small game, game birds, and waterfowl. (USFS 2015a)

The Routt National Forest is also a prime winter recreation area in this region, with Steamboat Springs Ski Resort, and trails for cross-country skiing, snowshoeing, and snowmobiling. Other recreational activities include: hiking, bicycling, mountain climbing, horseback riding, and other trail use; camping and picnicking; ice, lake, and river fishing, boating, swimming, waterskiing, and other water activities; and licensed, seasonal hunting and trapping. (USFS, 2015b)

Northeast Region

The Northeast Region consists primarily of the Front Range (the eastern edge of the Rocky Mountains) and the location of the more populated areas in Colorado (see Figure 3.1.7-3). The major metropolitan areas of Denver/Aurora, and Fort Collins are located here. To the east of the Rocky Mountains, recreational activities in this region center on the South Platte River and the grasslands that stretch to the Nebraska and Kansas borders.

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

Denver, the “mile-high city,” is known for its outdoor recreational enthusiasts. The city maintains over 85 miles of paved multi-use trails, as well as dirt trails used for mountain biking. The paved Greenway Trail follows the South Platte River, connects parks and playgrounds along the river, and ends at the Chatfield State Recreation Area, popular for sailing and swimming. The spectacular “Colorado Trail” begins on the outskirts of Denver and continues for approximately 500 miles to Durango, through eight mountain ranges and six wilderness areas at an average elevation of 10,000 feet (The Colorado Trail Foundation, 2016). The Continental Divide National Scenic Trail also crosses the state north and south, west of the Front Range. (Visit Denver, The Convention & Visitors Bureau, 2016)

Rocky Mountain National Park, to the west of Denver, is known for having 355 miles of alpine and subalpine hiking trails. Activities within the park include: hiking, bicycling, mountain climbing, horseback riding, and other trail use; campground and backcountry camping and picnicking; sport fishing and other water activities; and sledding and tubing, cross-country skiing and snowshoeing, and other winter activities. (NPS, 2015a) (NPS, 2016a)

Southwest Region

The San Juan Mountains are prominent here; and much of the Southeast Region contains national forests, with Gunnison, Uncompahgre, San Juan, and Rio Grande being some of the largest (Figure 3.1.7-3). Areas within the San Juan National Forest popular with visitors are wilderness areas Figure and historic sites, including historic mining ghost towns and Puebloan heritage sites. Mesa Verde National Park, Canyons of the Ancients National Monument, and Colorado's two American Indian reservations are located in this region. The Rio Grande National Forest is known for wilderness areas, the Wheeler Geologic Area, and the North Clear Creek Falls Observation Site. All these national forests have recreational activities including: hiking, bicycling, mountain climbing, horseback riding, and other trail use; camping and picnicking; fishing, boating, and other water activities; downhill skiing and snowboarding, sledding and tubing, cross-country skiing and snowshoeing, snowmobiling, and other winter activities; rock and mineral collecting; and licensed, seasonal hunting. (USFS, 2015c) (USFS, 2015d)

The Black Canyon of the Gunnison National Park contains the Painted Wall, a 2,250-foot cliff (taller than the Empire State Building) and the Curecanti National Recreation Area. The park is known for difficult hiking trails and steep mountain climbs. Other recreational activities within the park include: licensed fishing, kayaking, and rafting; camping; horseback riding; and cross-country skiing, snowshoeing, and other winter sports.(NPS, 2015o)

Southeast Region

In this region, the 14,110 ft mountain “Pikes Peak” is adjacent to the city of Colorado Springs; and the prominent Sangre de Cristo mountain range lies farther south, to the west of Pueblo, Colorado. East of these Front Range, the eastern plains of Colorado stretch to the Kansas border. The Comanche National Grasslands are located on those plains and include Picket Wire Canyon, a paleontological site containing the largest documented collection of dinosaur trackways in North America (Figure 3.1.7-3). The Great Sand Dunes National Park and Preserve, to the west of the Sangre de Cristos has 750-foot sand dunes popular for hiking and sandboarding. Medano

Creek, on the east side of the dunes, is a unique waterbody characterized by surge flow, making skimboarding, and wading popular there. Other activities within the park include backpacking, horseback riding, and restricted hunting. (USFS 2015e)

Pike and San Isabel National Forests (ranked third in the nation for number of recreational visits) have units in this region. Recreational activities popular within the forests include: hiking, bicycling, mountain climbing, and other trail use; camping and picnicking; fishing, boating, and other water activities; cross-country skiing, snowshoeing, snowmobiling, and other winter activities; rock and mineral collecting; and licensed, seasonal hunting and trapping. A segment of the Santa Fe National Historic Trail also passes through this region. (NPS 2015c)

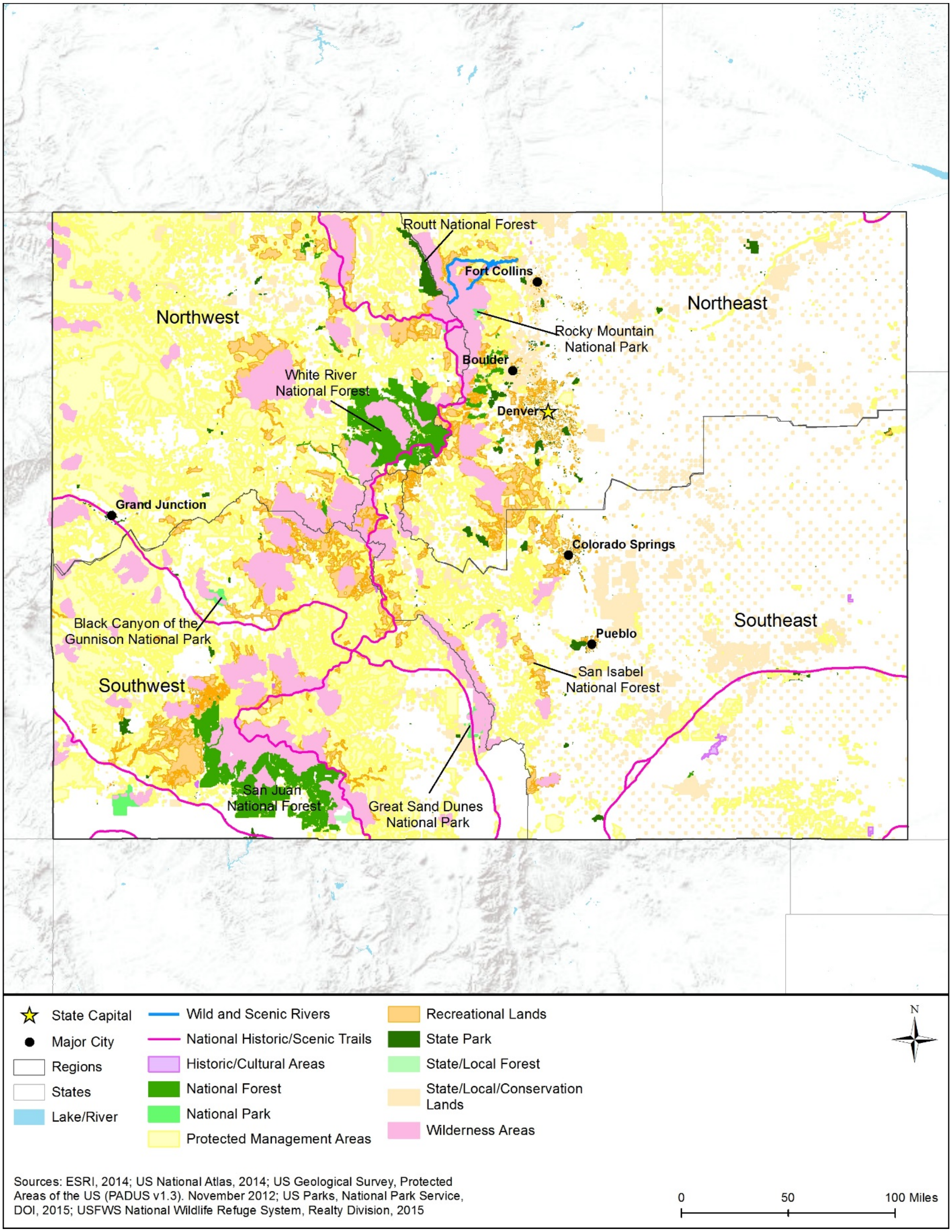

Figure 3.1.7-3: Colorado Recreation Resources

3.1.7.5. Airspace

The FAA uses the NAS to provide for aviation safety. The NAS includes Special Use Airspace (SUA) consisting of Restricted Areas, Warning Areas, and Military Operation Areas (MOAs). The FAA controls the use of the NAS with various procedures and practices (such as established flight rules and regulations, airspace management actions, and air traffic control procedures) to ensure the safety of aircraft and protection of the public.

Airspace Categories

There are two categories of airspace or airspace areas:

1) Regulatory airspace consists of controlled airspace (Class A, B, C, D, and E airspace areas in descending order of restrictive operating rules), and restricted and prohibited areas.
2) Non-regulatory airspace consists of MOAs, warning areas, alert areas, and controlled firing areas.

Within each of these two categories, there are four types of airspace: controlled, uncontrolled, special use, and other airspace. The categories and types of airspace are dictated by the complexity or density of aircraft movements, the nature of the operations conducted within the airspace, the level of safety required, and the national and public interest. Figure 3.1.7-4 depicts the different classifications and dimensions for controlled airspace. Air Traffic Control (ATC)[116] service is based on the airspace classification (FAA, 2008a).

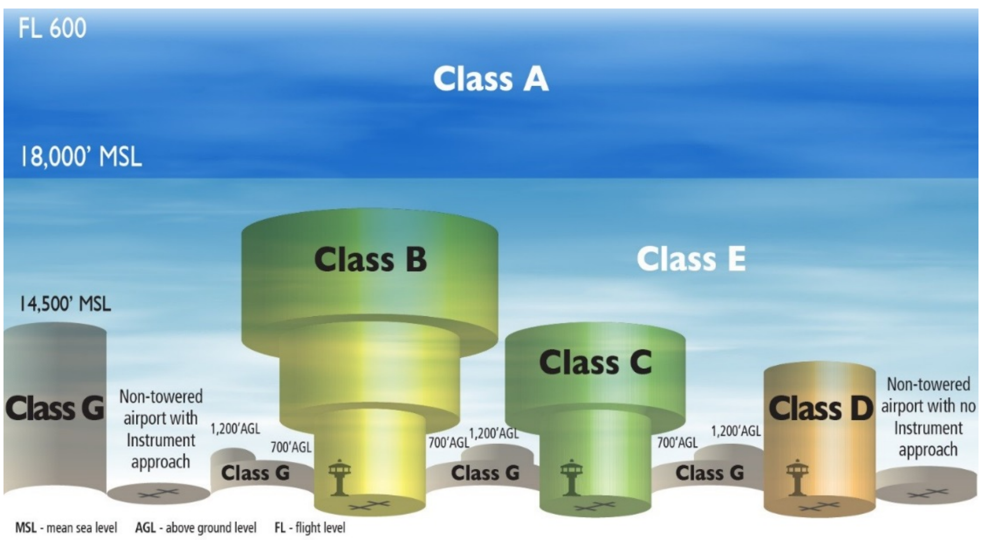

Figure 3.1.7-4: National Air Space Classification Profile

Source: Derived from (FAA, 2008a)

[116] ATC – Approved authority service to provide safe, orderly, and expeditious flow of air traffic operations. (FAA, Federal Aviation Administration Aeronautical Information Manual, 2014)

Controlled Airspace

- **Class A:** Airspace from 18,000 feet to 60,000 feet Mean Sea Level (MSL).[117] 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).[118]
- **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, 2008a).

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 3.1.7-5).

[117] 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, 2007)
[118] IFR – Rules for the conduct of flights under instrument meteorological conditions (FAA, 2015c).

Table 3.1.7-5: SUA Designations

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

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

Other Airspace Areas

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

Table 3.1.7-6: Other Airspace Designations

Type	Definition
Airport Advisory	There are three types: • Local Airport Advisory – Operated within 10 statute miles of an airport where there is a Flight Service Station (FSS) located on an airport, but no operational control tower. The FSS advises the arriving and departing aircraft on particular conditions. • Remote Airport Advisory – Operated within 10 statute miles for specific high activity airports with no operational control tower. • Remote Airport Information Service – Used for short-term special events.
MTRs	MTRs are for use by the military for training, specifically low level combat tactics where low altitudes and high speed are needed.
TFRs	TFRs are established to: • Protect people and property from a hazard; • Provide safety for disaster relief aircraft during operations; • Avoid unsafe aircraft congestion associated with an incident or public interest event; • Protect the U.S. President, Vice President, and other public figures; • Provide safety for space operations; and • Protect in the state of Hawaii declared national disasters for humanitarian reasons. Only those TFRs annotated with an ending date and time of “permanent” are included in this Draft PEIS, since it indicates a longer, standing condition of the airspace. Other TFRs are typically a shorter duration of for a one-time specific event.
Parachute Jump Aircraft Operations	Parachute jump area procedures are in 14 CFR Part 105, while the U.S. parachute jump areas are contained in the regional Airport/Facility Directory.
Published VFRs and IRs	These are established routes for moving around and through complex airspace, like Class B airspace. VFRs are procedures used to conduct flights under visual conditions. IFRs are procedures used to conduct flights with instruments and meteorological conditions.
Terminal Radar Service Areas	Airspace areas that are not one of the established U.S. airspace classes. These areas provide additional radar services to pilots.

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

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, 2013a).

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.

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 or alteration of a facility that may impinge upon the NAS. Per 14 CFR Part 77.9, the FAA is to be notified about construction or alterations when:

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

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

3.1.7.6. Colorado Airspace

Within the organizational structure of the CDOT is the Colorado Division of Aeronautics whose responsibility is to ensure an effective air transportation system (CDOT, 2015c). The Colorado Aeronautics Board (CAB), created by statute in 1988, is comprised of government and aviation representatives appointed by the Governor to serve in a three-year term. The CAB oversees aviation development working with the Colorado Division of Aeronautics, who also serves as technical advisors to the CAB on aviation safety (CDOT, 2015d). There is one FAA FSDO for Colorado located in Denver (FAA, 2015b).

Colorado airports are classified as those included in the State Aviation System Plan (SASP) and those that are not part of the SASP. The SASP addresses the strategic planning and future development for the state's airport system, as well as addressing key issues associated with their airports (U.S. Census Bureau, 2015w). Figure 3.1.7-5 presents the different aviation airports/facilities located in Colorado, while Figure 3.1.7-6 and Figure 3.1.7-7 present the breakout by public and private airports. There are approximately 455 airports (public and private) within Colorado as presented in Table 3.1.7-7 and Figure 3.1.7-5 through Figure 3.1.7-7 (U.S. Department of Transportation 2015).

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

Type of Airport or Facility	Public	Private
Airport	74	199
Heliport	0	179
Seaplane	0	0
Ultralight	0	1
Balloonport	0	1
Gliderport	0	1
Total	**74**	**381**

Source: (U.S. Department of Transportation 2015)

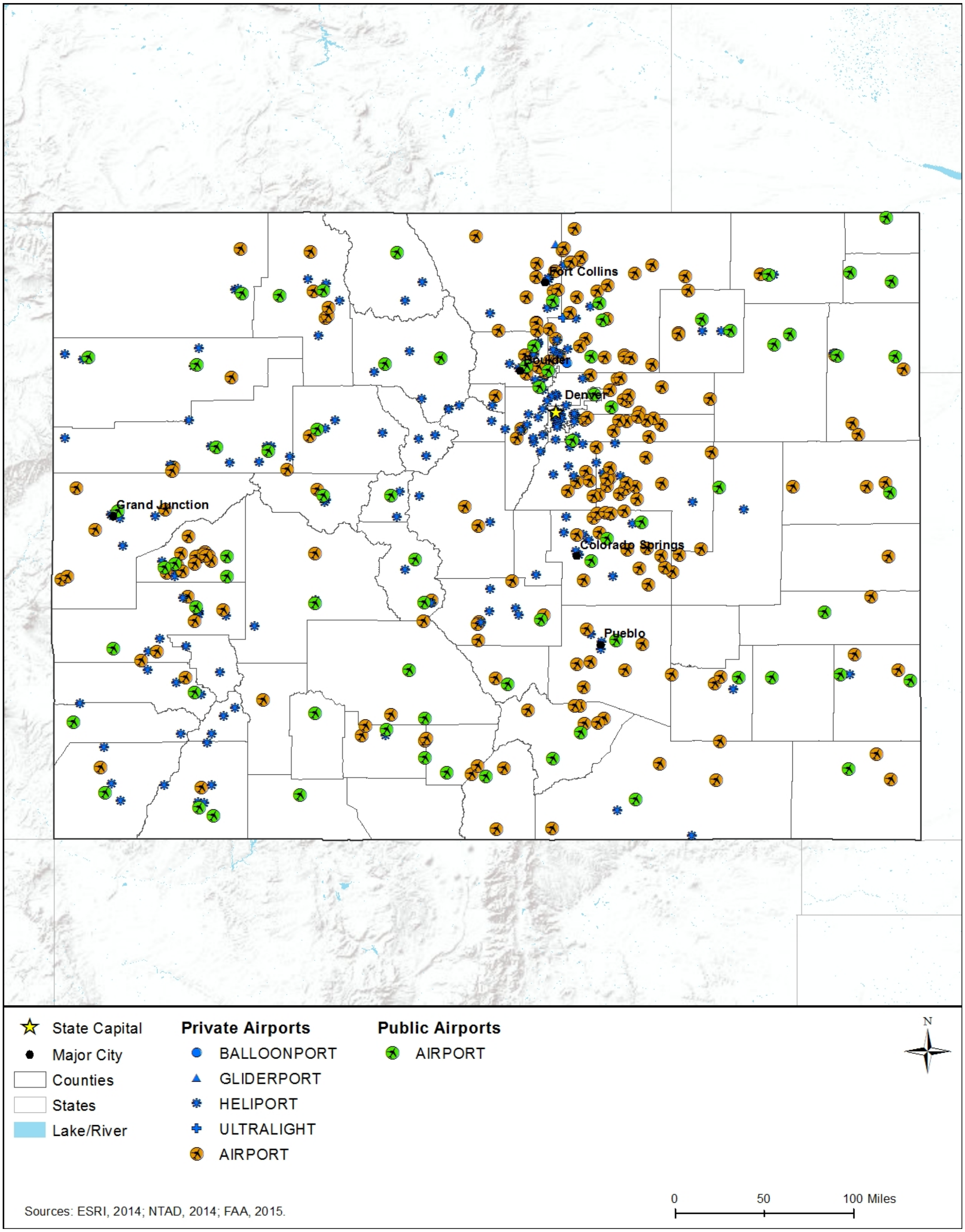

Figure 3.1.7-5: Public and Private Airports/Facilities in Colorado

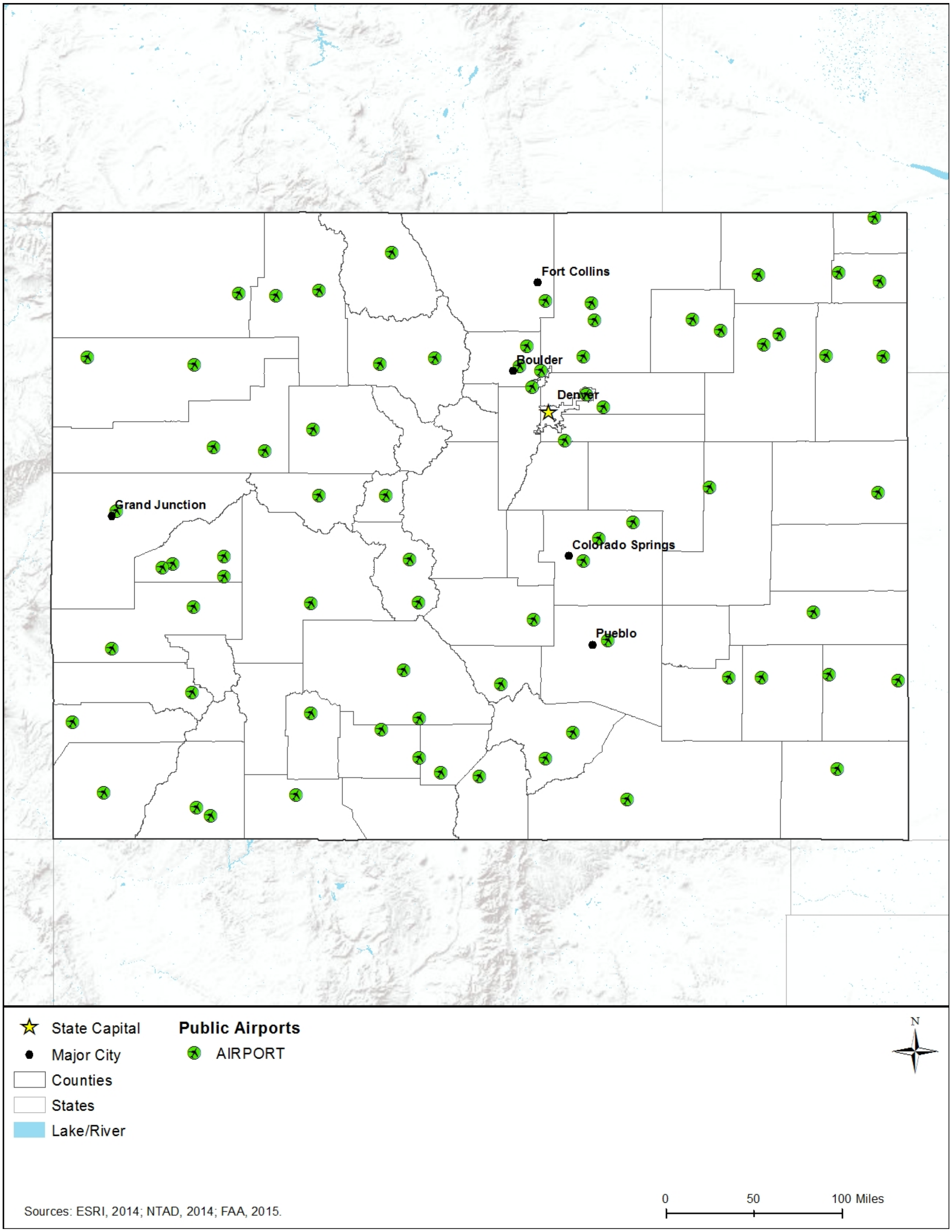

Figure 3.1.7-6: Public Colorado Airports/Facilities

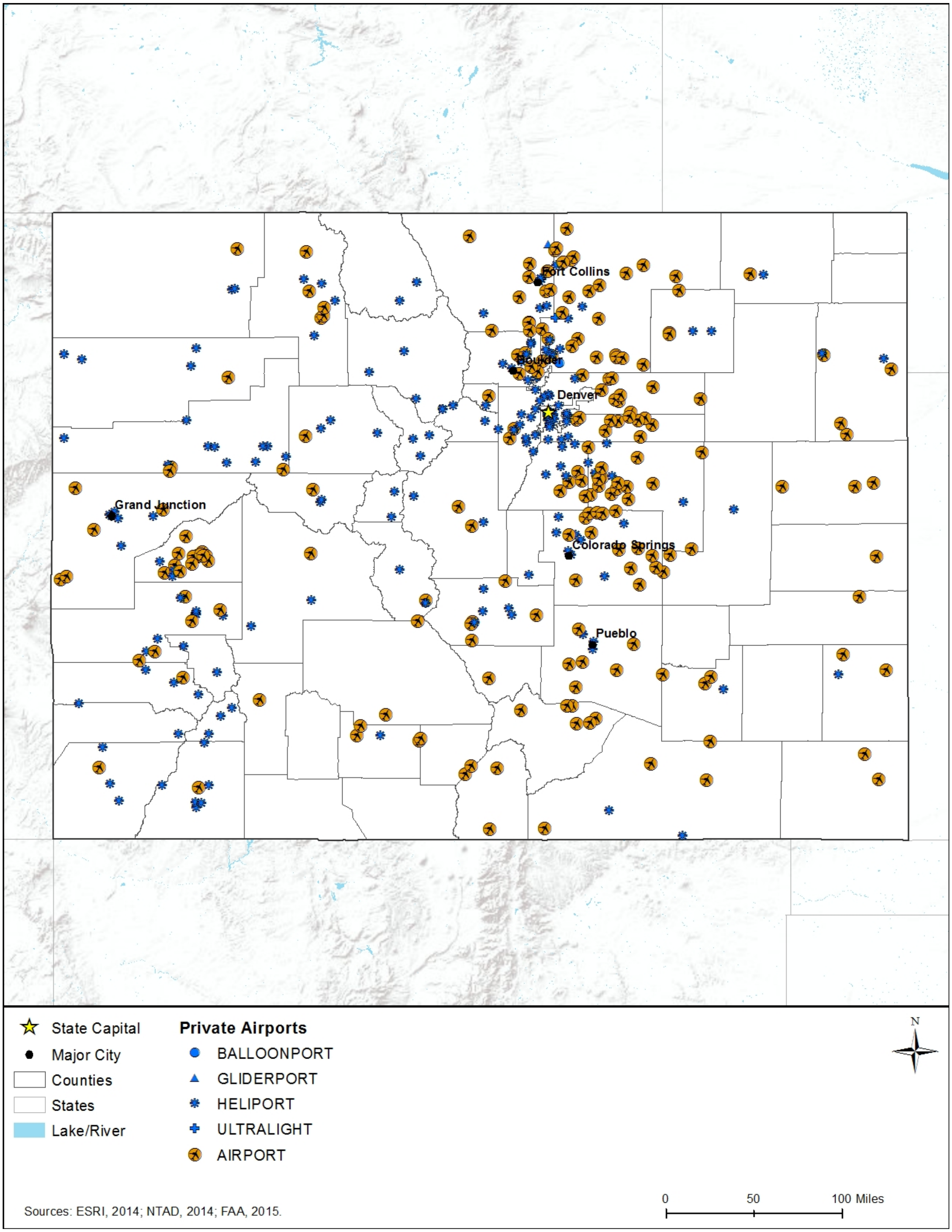

Figure 3.1.7-7: Private Colorado Airports/Facilities

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

- One Class B –
  - Denver International
- One Class C –
  - City of Colorado Springs Municipal – Colorado Springs
- Ten Class D –
  - Aspen-Pitkin County/Sardy Field – Aspen
  - Aurora, Buckley Air National Guard Base – Aurora
  - Jefferson County – Broomfield
  - Colorado Springs U.S. Air Force (USAF) Academy Airstrip – Colorado Springs USAF Academy
  - Eagle County Regional
  - Centennial Airport – Englewood
  - Butts Army Airfield – Fort Carson
  - Front Range Airport - Denver
  - Grand Junction Regional – Grand Junction
  - Pueblo Memorial – Pueblo, CO. (FAA, 2013b)

SUAs (i.e., 5 restricted, 10 MOAs, 3 Alert Areas, and 1 NSA) located in Colorado are as follows:

- Fort Carson (Restricted)
  - R-2601A – Surface to, but not including, 12,500 feet MSL
  - R-2601B – 12,500 feet MSL to, but not including, 22,500 feet MSL
  - R-2601C – 22,500 feet MSL to, but not including, 35,000 MSL
  - R-2601D – 35,000 feet MSL to, but not including, 60,000 feet MSL
- Colorado Springs (Restricted)
  - R-2602 – Surface to 1,000 feet AGL. (FAA, 2014a)

The 10 MOAs for Colorado are as follows:

- Airburst –
  - A – 1,500 feet AGL to, but not including, FL 180
  - B – 500 feet AGL to, but not including, FL 180
  - C – 500 feet AGL to, but not including, 8,500 feet MSL
- Cheyenne –
  - High – 13,500 feet MSL to, but not including, FL 180
  - Low – 300 feet AGL to, but not including, 9000 Feet MSL excluding that airspace 1,500 AGL and below within three NM around the Cheyenne Wells airport
- La Veta –
  - High – 13,000 feet MSL to, but not including, FL 180
  - Low – 1,500 feet AGL to, but not including, 13,000 feet MSL
- Pinon Canyon – 100 feet AGL to and including 10,000 feet MSL

- Two Buttes –
  - High – 10,000 feet MSL to, but not including, FL 180
  - Low – 300 feet AGL to, but not including 10,000 MSL. (FHWA, 2014b)

The Mount Dora North High/Low MOAs of New Mexico extend into the southeastern portion of the state below Pueblo (FHWA, 2014b). There are three Alert Areas as follows:

- A-260 Colorado Springs – From the surface to 17,000 feet MSL
- A-639A Academy – 3,000 feet AGL to and including 12,000 feet MSL
- A-639B Academy – 3,000 feet AGL to and including 12,000 feet MSL. (FHWA, 2014b)

The SUAs for Colorado are presented in Figure 3.1.7-8. There are no TFRs for Colorado, however, there is a National Security Area (NSA 0015) [119] located around Pueblo (See Figure 3.1.7-8) with an altitude restriction of surface to 3,000 feet AGL within a three NM radius from the centered latitude and longitude points (FAA, 2015e). The restrictions associated with this NSA may impact the airspace in the area. MTRs in Colorado, presented in Figure 3.1.7-9, consist of seven Visual Routes and fourteen Instrument Routes.

UAS Considerations

The NPS signed a policy memorandum on June 20, 2014 that "directs superintendents nationwide to prohibit launching, landing, or operating unmanned aircraft on lands or waters administered by the National Park Service" (NPS, 2014d). Thirteen national parks within the state of Colorado have to comply with this agency directive (NPS, 2015n).

[119] 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. (FAA, 2016)

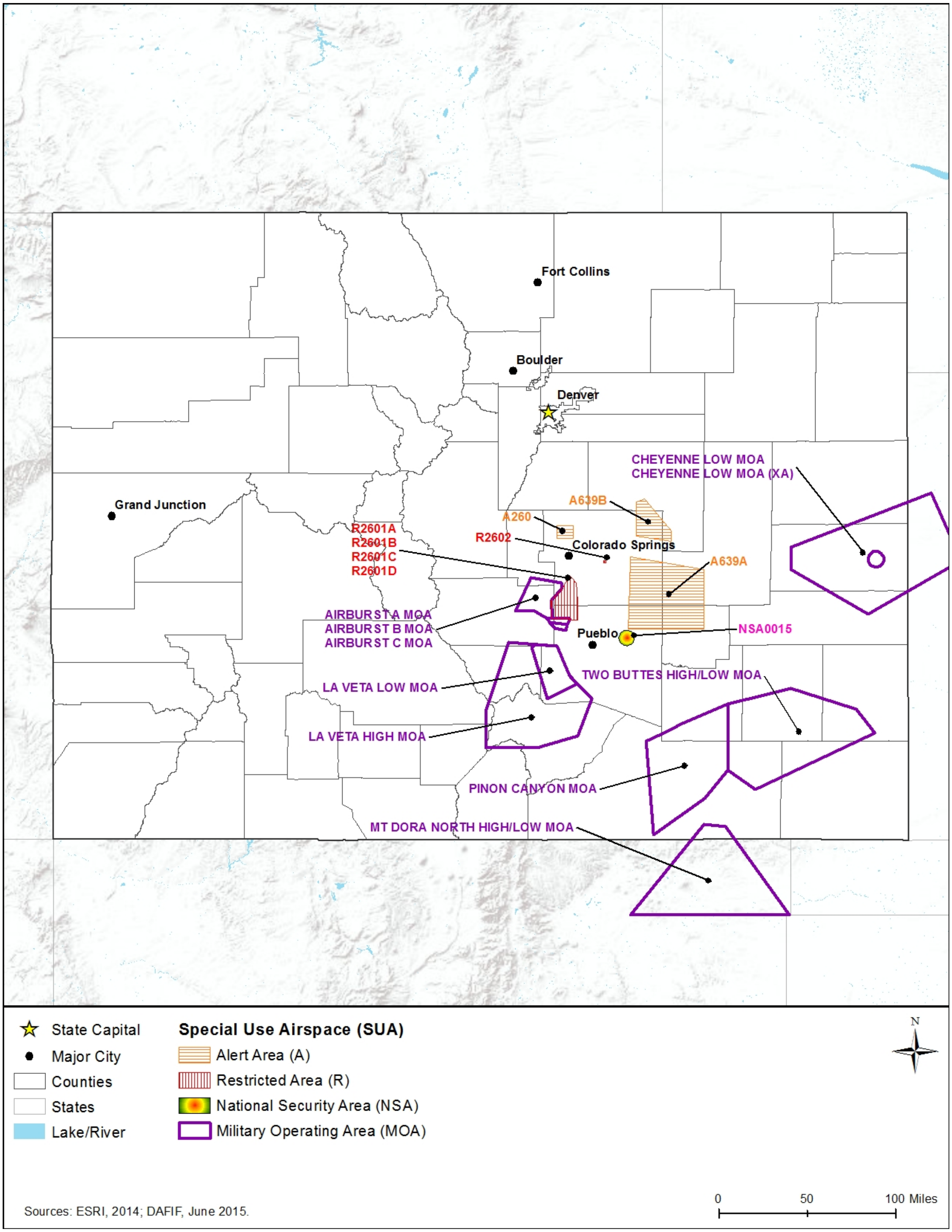

Figure 3.1.7-8: SUAs in Colorado

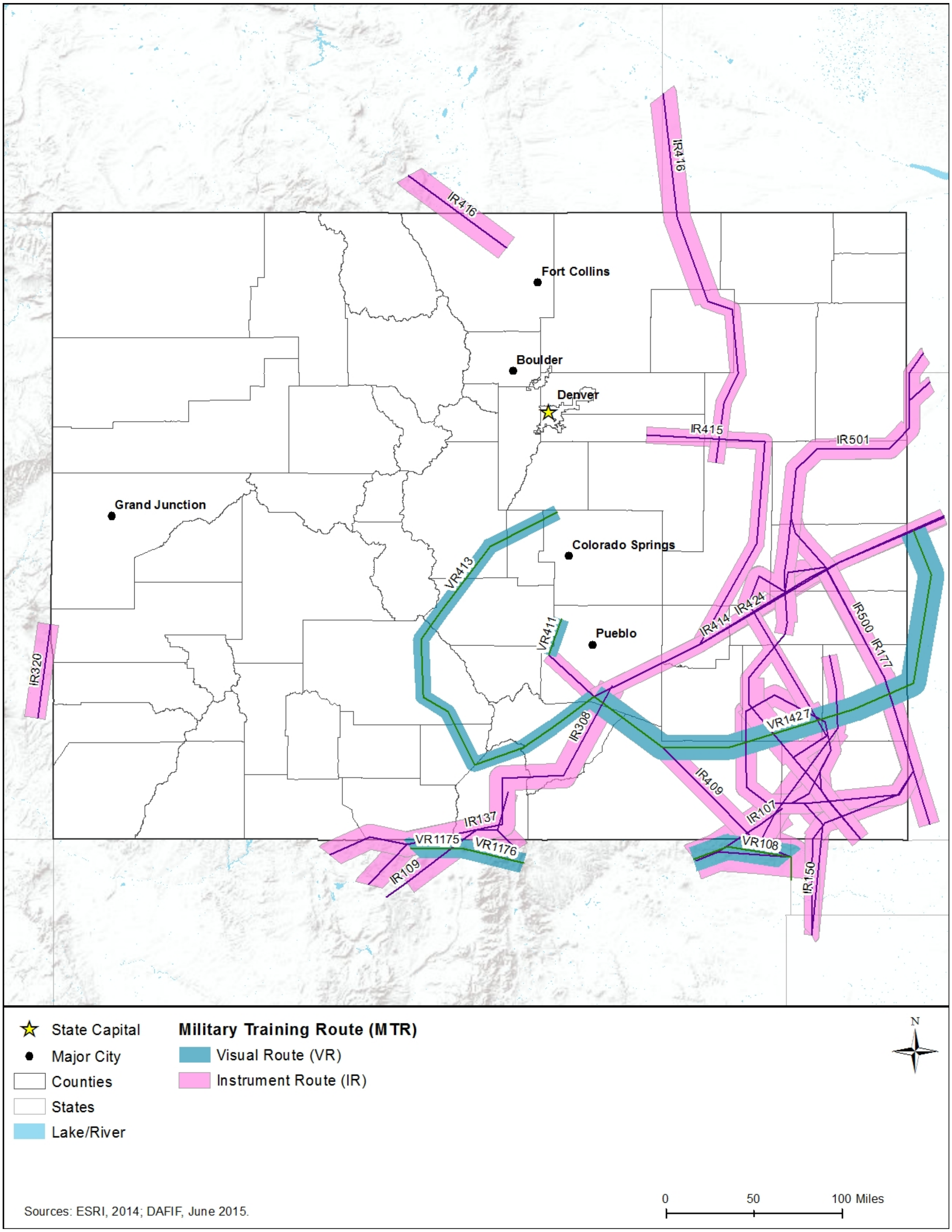

Figure 3.1.7-9: MTRs in Colorado

3.1.8. Visual Resources

3.1.8.1. Definition of the Resource

Visual resources influence the human experience of a landscape. Various aspects combine to create visual resources, such as color, contrast, texture, line, and form. Features (e.g., mountain ranges, city skylines, ocean views, unique geological formations, rivers) and constructed landmarks (e.g., bridges, memorials, cultural resources, or statues) are considered visual resources. For some, cityscapes are valued visual resources, whereas others prefer natural areas. While many aspects of visual resources are subjective, evaluating potential impacts on the character and continuity of the landscape is a consideration when evaluating proposed actions for NEPA and NHPA compliance. The federal government does not have a single definition of what constitutes a visual resource; therefore, this PEIS will use the general definition of visual resources used by the Bureau of Land Management, "the visible physical features on a landscape (e.g., land, water, vegetation, animals, structures, and other features)"(BLM, 1984).

3.1.8.2. Specific Regulatory Considerations

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

Table 3.1.8-1: Relevant Colorado Visual Resources Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Colorado Land Use Act (Colorado Statutes, Title 24, Article 65.1 – Areas and Activities of State Interest)		Allows state and local agencies to administer "areas containing, or having a significant impact upon, historical, natural, or archaeological resources of statewide importance, as determined by the state historical society, the department of natural resources, and the appropriate local government, [with] the appropriate state agency in conjunction with the appropriate local government in a manner that will allow man to function in harmony with, rather than be destructive to, these resources. Consideration is to be given to the protection of those areas essential for wildlife habitat. Development in areas containing historical, archaeological, or natural resources shall be conducted in a manner which will minimize damage to those resources for future use."
Colorado Natural Areas Act of 1977	Colorado Parks and Wildlife	Establishes the Colorado Natural Areas Program (CNAP) for the protection of "certain lands and waters of [the] state representing diverse ecosystems, ecological communities, and other natural features or phenomena, which are…natural heritage, are increasingly threatened with irreversible change and are in need of special identification and protection…to preserve, protect, perpetuate, and enhance specific examples of these natural features and phenomena as an enduring resource."
Great Outdoors Colorado Amendment (Article XXVII of the Colorado Constitution)	State Board of Great Outdoors Colorado Trust Fund	Directs lottery proceeds for capital construction to projects that "preserve, protect, and enhance Colorado's wildlife, park, river, trail and open space heritage." Establishes the State Board of Great Outdoors Colorado Trust Fund to administer the redirected funding.

State Law/Regulation	Regulatory Agency	Applicability
State History, Archives and Emblems (CRS, Title 24, Article 80.1 – Register of Historic Places)	Colorado State Historical Society	Establishes a state register of historic places for "sites and structures possessing historical significance." Also establishes the State Historical Society, duties of the society and criteria for inclusion in the state register.

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

3.1.8.3. Character and Visual Quality of the Existing Landscape

Colorado has a wide range of visual resources. The state is home a diverse landscape including the highest sand dunes in the country, 54 Rocky Mountain summits including alpine landscapes, grasslands, red-rock formations, green forests, mesas, lakes, hot springs, and deep river canyons. There are seven primary mountain ranges in the state, including the southern Front Range of the Rocky Mountains, which includes Pike's Peak, one of Colorado's fourteeners – a mountain exceeding 14,000 feet above sea level (Colorado Tourism Office, 2015). The Continental Divide passes through the state along the Rocky Mountains. Its capital city is Denver, and is known as the Mile-High City because its elevation is exactly one mile above sea level.

More than half of Colorado is characterized as forested or pasture/range lands (Figure 3.1.7-1). Pasture/range lands are the most dominant landscape in the state (USDA Economic Research Service, 2015). Their primary vegetation is herbaceous plant and shrubs for foraging livestock. Pasture is different from range in that its vegetation is introduced and propagated to provide preferred forage for grazing livestock. Forested areas are the second most prevalent visual resource within the state. Visual resources within forested areas are generally comprised of continuous, natural looking cover with gradual transitions of line and color. They are typically characterized by the lack of disturbance or disruption of the landscape (NRCS, 2015f).

While the state and many municipalities have some regulation of scenic and visual resources, not all scenic areas within the state have been identified or have policy or regulations for management or protection by the state. The areas listed below have some measure of management, significance, or protection through state or federal policy, as well as being identified as a visually significant area.

3.1.8.4. Visually Important Historic Properties and Cultural Resources

Visual and aesthetic qualities of historic properties can contribute to the overall importance of a particular site. Such qualities relate to the integrity of the appearance and setting of these properties or resources. Viewsheds (the natural and manmade environment visible from one or more viewing points) can also contribute to the significance of historic properties or cultural resources (NASA, 2013). Viewsheds containing historic properties and cultural resources may be considered important because of their presence in the landscape. Figure 3.1.8-1 shows areas that are included in the National Register of Historic Places (NRHP) that may be considered visually sensitive. In Colorado, there are 1,480 NRHP listed sites, which include 2 National

Historic Sites, 3 National Heritage Areas, and 4 National Historic Trails (NPS, 2015l). 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 Heritage Areas

National Heritage Areas (NHAs) are "places where natural, cultural, and historic resources combine to form a cohesive, nationally important landscape" (NPS, 2011). These areas help tell the history of the United States. Based on this criteria, NHAs in Colorado may contain scenic or aesthetic areas considered visual resources or visually sensitive. There are three NHAs in Colorado: Cache La Poudre River Corridor, South Park National Heritage Area and Sangre de Cristo National Heritage Area (Figure 3.1.8-1) (NPS, 2016b).

National Historic Landmarks

National Historic Landmarks (NHLs) are defined as "nationally significant historic places designated by the [U.S.] Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States" (NPS, 2015d). NHLs may include "historic buildings, sites, structures, objects, and districts" (NPS, 2016c). Other types of historic properties include battlefields and canals. The importance of NHL-designated properties can be attributed to scenic or aesthetic qualities, among other attributes, that may be considered visual resources or visually sensitive at these sites. In Colorado, there are 25 NHLs, including sites such as the Georgetown-Silver Plume Historic District, Bent's Old Fort National Historic Site, Elitch Gardens Carousel, Pikes Peak and the Lindenmeier Site (Figure 3.1.8-1) (NPS, 2015e). By comparison, there are over 2,500 NHLs in the United States, less than 1 percent of these located in Colorado (NPS, 2015f). Figure 3.1.8-1 provides a representative sample of some historic and cultural resources that may be visually sensitive.

National Historic Sites

Colorado has two National Historic Sites which are preserved by the NPS to "commemorate persons, events, and activities important in the nation's history." (NPS, 2003). The two national historic sites in Colorado include Bent's Old Fort and Sand Creek Massacre (NPS, 2015b). These sites may contain aesthetic and scenic values associated with history. Locations of the above are identified on the map in Figure 3.1.8-1.

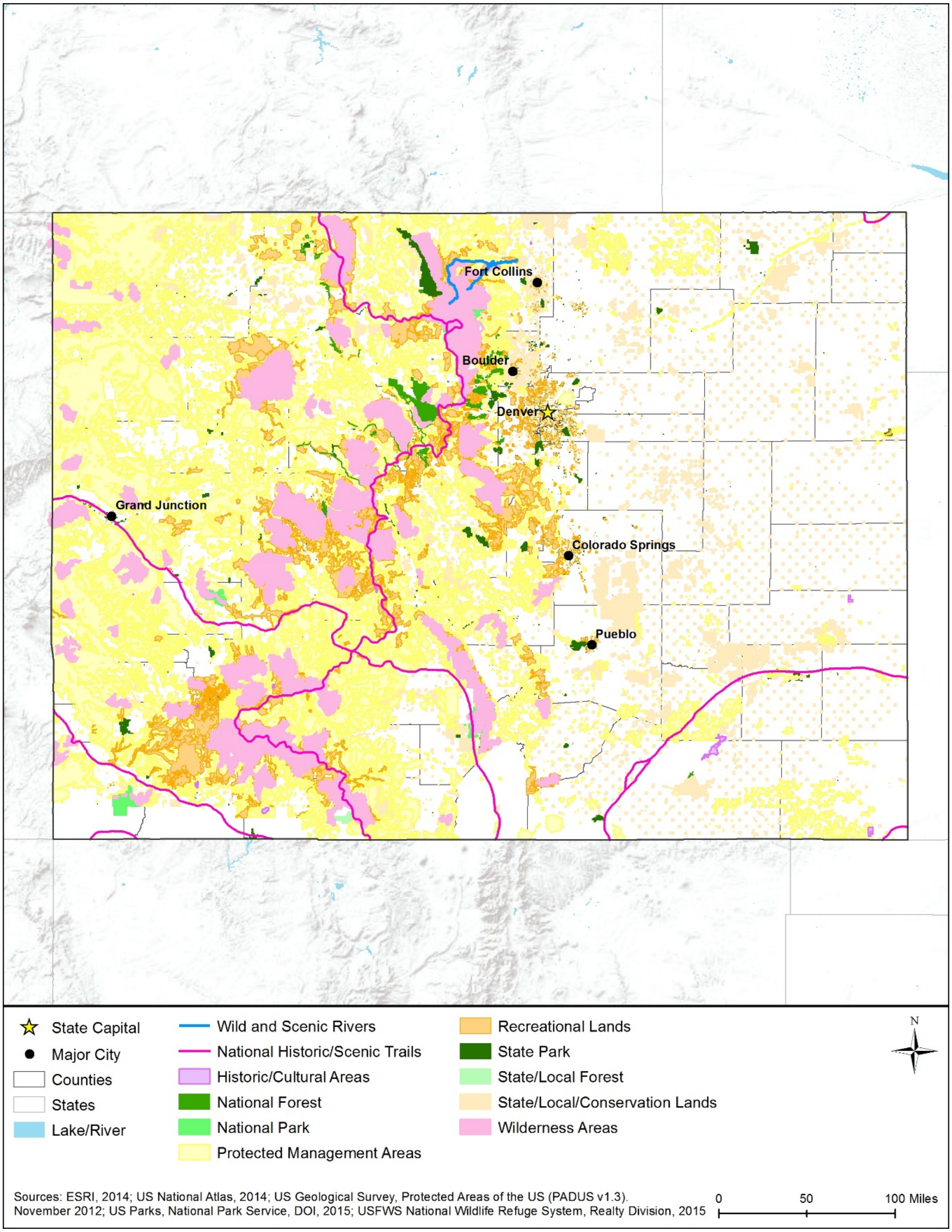

Figure 3.1.8-1: Representative Sample of Some Historic and Cultural Resources that May be Visually Sensitive

State Historic Sites, Resources, and Parks

Colorado's historical society, History Colorado, maintains eleven state historic sites and museums under its purview. The three historic sites include Pike's Stockade, Dexter Cabin and Georgetown Loop Historic Mining & Railroad Park. Other sites and museums include the History Colorado Center, Byers-Evans House Museum, Fort Garland Museum, Fort Vasquez Museum, Healy House Museum and Trinidad History Museum. (History Colorado, 2015)

3.1.8.5. Parks and Recreation Areas

Parks and recreation areas include state parks, state forests, National Parks, National Recreation Areas, National Forests, National Preserves, and National and State Trails. Parks and recreation areas often contain scenic resources and tend to be visited partly because of their associated visual or aesthetic qualities. Figure 3.1.7-1 in Section 3.1.7, Land Use, Airspace, and Recreation, identifies parks and recreational resources that may be visually sensitive in Colorado. For additional information about recreation areas, including national and state parks, see Section 3.1.7, Land Use, Airspace, and Recreation.

State Parks

State parks contain natural, historic, cultural, and/or recreational resources of significance to Colorado residents and visitors. There are 42 state parks throughout Colorado, most of which contain scenic or aesthetic areas considered to be visual resources or visually sensitive (CPW, 2015g). Table 3.1.8-2 contains a sampling of state parks and their associated visual attributes. For a complete list of state parks, see the Colorado Parks & Wildlife websit*e* (CPW, 2015k).

Table 3.1.8-2: Examples of Colorado State Parks and Associated Visual Attributes

State Park	Visual Attributes
Barr Lake State Park	Lake vistas, wildlife, prairie.
Castlewood Canyon	Canyon, prairie, creek, wildlife, riparian landscape, caprock, and grassy uplands, "rock layer cake," homestead remnants, Castlewood Dam.
Lathrop	Spanish Peaks vistas, Martin Lake, lake beach, Greenhorn Mountain vistas, Pikes Peak vistas, wetland, riparian areas, grasslands, pinon juniper habitats, wildlife.
Mueller	Forests, spring-fed mountain meadows, wildflowers, granite rock formations, Pikes Peak vistas, wildflowers, wildlife, backcountry pond, panoramic views of the Continental Divide.
San Luis	High mountain valley, Sangre de Cristo Mountain views, Great Sand Dunes vistas, wetlands, lakes, open valley, wildlife, low dunes.

Source: (CPW, 2015g)

Figure 3.1.8-2: Mueller State Park

Source: (CPW, 2015h)

State Forests

Non-federally managed forest land in Colorado accounts for 32 percent of the state's forests. These lands are owned and managed privately (30 percent or 7.1 million acres), by state agencies such as the Colorado State Land Board (370,000 acres), by local government and municipalities, or by resident tribes (402,303 acres). The visual resources in these areas consist of ponderosa pine, pinon-juniper, aspen, and mixed conifer forest types. (CSFS, 2015a)

U.S. National Park System and Bureau of Land Management

National Parks are managed by the NPS and contain natural, historic, cultural, visual, ecological, and recreational resources of significance to the nation and are maintained for the public's use. In Colorado, there are 13[120] NPS units, which include 2 National Historic Sites, 3 National Parks, 3 National Heritage Areas, 4 National Historic Trails, 5 National Monuments, 1 National Recreation Area and 1 National Park and Preserve (NPS, 2015b). Some of these resources managed by the NPS are combined to be a single NPS unit (e.g., a monument within a park). Figure 3.1.8-4[121] identifies the

Figure 3.1.8-3: Curecanti National Recreation Area

Source: (NPS, 2015g)

[120] This count is based on the NPS website "by the numbers" current as of 9/30/2014 (NPS, 2015l). Actual lists of parks and NPS affiliated areas may vary here depending on when areas are designated by Congress.

[121] The natural areas data were retrieved from the Protected Areas Database of the United States (PAD-US), produced by USGS (http://gapanalysis.usgs.gov/padus/). This dataset categorizes lands across the U.S. by conservation, land management, planning, recreation, and ownership, as well as other uses. It is an extensive data set that contains large quantities of information relevant to the Proposed Action. The data was queried and further combined by the Primary Designation Type into classifications that fit

National Parks and affiliated areas located in Colorado. For additional information regarding parks and recreation areas, see Section 3.1.7, Land Use, Recreation, and Airspace.

Table 3.1.8-3: Colorado National Park Service Areas

NPS Area Name	
Bent's Old Fort National Historic Site	Hovenweep National Monument
Black Canyon of the Gunnison National Park	Mesa Verde National Park
Cache La Poudre River National Heritage Area	Old Spanish National Historic Trail
California National Historic Trail	Pony Express National Historic Trail
Colorado National Monument	Rocky Mountain National Park
Continental Divide National Scenic Trail[a]	Sand Creek Massacre National Historic Site
Curecanti National Recreation Area	Sangre de Cristo National Heritage Area
Dinosaur National Monument	Santa Fe National Historic Trail
Florissant Fossil Beds National Monument	South Park National Heritage Area
Great Sand Dunes National Park & Preserve	Yucca House National Monument

Source: (NPS, 2015b) (USFS, 2016b) (NPS, 2016d) (South Park Heritage, 2016)

[a] Continental Divide National Scenic Trail is within Rocky Mountain National Park

the multiple types of land applicable for Natural Areas. For this map, recognizable symbols (e.g., varying shades of green for National Parks and Forests) were used as PAD-US does not have a standard symbolization for natural areas. The PADUS 1.3 geodatabase was downloaded in the summer of 2015, and used consistently throughout all these maps for each state and D.C.

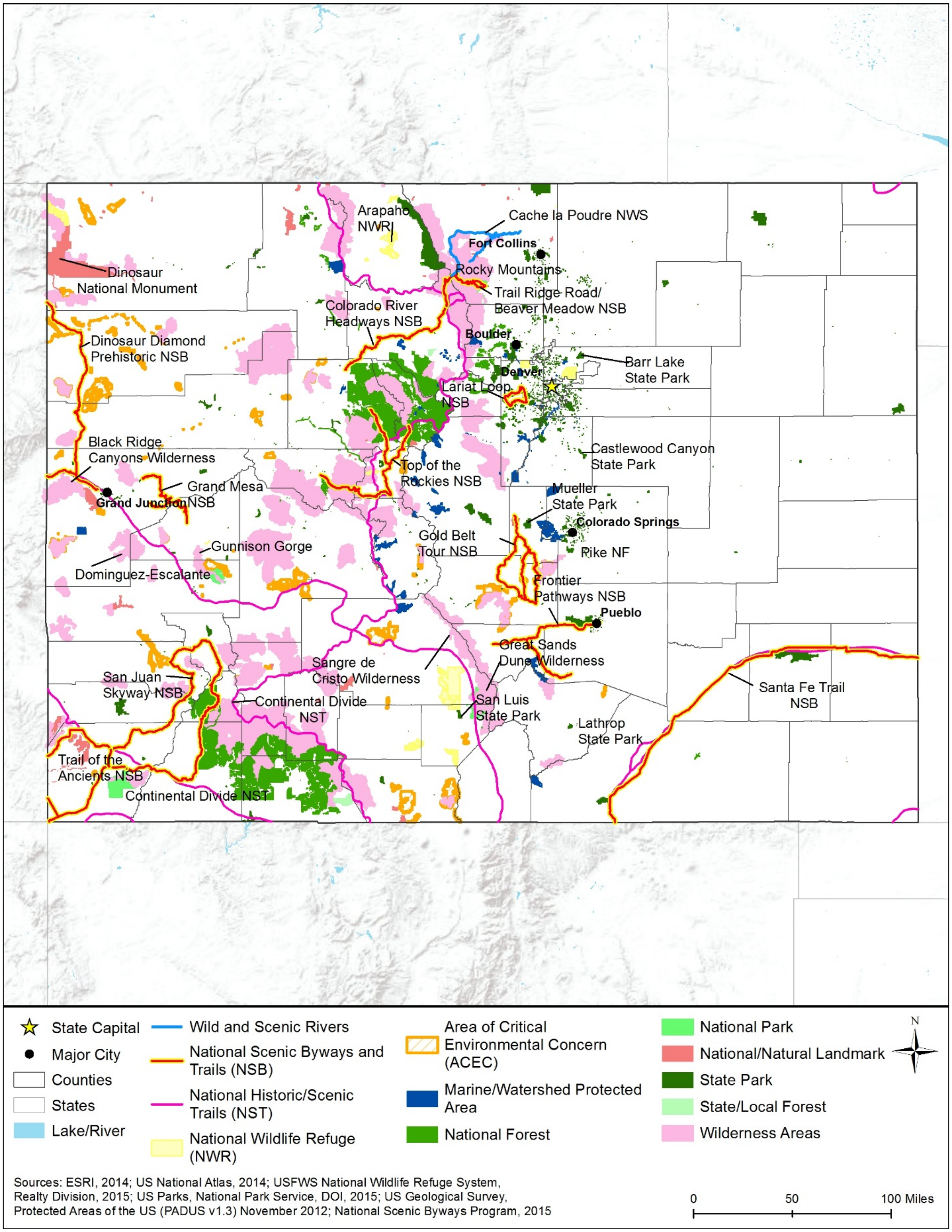

Figure 3.1.8-4: Natural Areas that May be Visually Sensitive

The BLM manages 8.3 million acres throughout Colorado (BLM, 2015a) including 5 Wilderness Areas, 3 Conservation Areas, 2 National Monuments and 2 National Scenic and Historic Trails. Table 3.1.8-4 identifies the BLM units in Colorado. These lands are managed under a multiple use mandate (FLPMA) meaning that BLM must allow many uses of the lands, from recreation, to livestock grazing, forestry, wildlife habitat, and energy development (BLM, 2015b). The BLM uses their visual resources management system to "identify and evaluate scenic values to determine the appropriate levels of management." Lands that are classified with high scenic values are assigned management that prevents or reduces impacts to the visual resources, protecting the scenic landscape (BLM, 2012). BLM lands with high scenic values are less likely to be developed or have the visual resources disturbed. Management varies among uses and resources, some areas, like lands adjacent to wild and scenic rivers, will be managed for high quality visual resources. Other areas, such as where energy development is occurring, may be managed for lower quality visual resources (BLM, 2013).

Table 3.1.8-4: Colorado BLM Service Areas

BLM Area Name	
Browns Canyons	Gunnison Gorge National Conservation Area
Black Ridge Canyons Wilderness	Gunnison Gorge Wilderness
Canyons of the Ancients	McInnis Canyons National Conservation Area
Continental Divide National Scenic Trail	Old Spanish National Historic Trail
Dominguez Canyon Wilderness	Powderhorn Wilderness
Dominguez-Escalante National Conservation Area	Uncompahgre Wilderness

Source: (BLM, 2015a)

National Monuments

NPS defines a national monument as a "nationally significant resource…smaller than a national park and [lacking]…diversity of attractions." Colorado is home to 5 national monuments managed by NPS including Colorado, Dinosaur, Florissant Fossil Beds, Hovenweep and Yucca House.

Additionally, the BLM designates national monuments to "afford protection, conservation, and restoration to landscapes of tremendous beauty, diversity, and historic or scientific interest." There are two national monuments administered by BLM in Colorado: Canyons of the Ancients and Browns Canyon (BLM, 2015c).

National Forests

Several agencies manage forested areas in Colorado, including the USFS (11.3 million acres), BLM (4.2M acres), and the NPS (380,925 acres) (CSFS, 2015a). There are 13 National Forests managed by the USFS in Colorado (Table 3.1.8-5 and Figure 3.1.8-4) (USFS, 2013). 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).

Table 3.1.8-5: National Forests in Colorado

National Forest Name	Acres (million)	Visual Resources
Arapaho and Roosevelt National Forests and Pawnee National Grassland	1.5	Grasslands, wooded forests, lakes, creeks
Grand Mesa, Gunnison and Uncompahgre National Forests	3.2	Mountain views, canyons, creeks, waterfalls, 300 lakes, flat top mountains, Alpine Tunnel
Pike and San Isabel National Forests and Comanche National Grasslands	3	Prairies, Rocky Mountains, alpine lakes, reservoirs, rivers, wilderness areas, wildlife, canyonlands
Rio Grande National Forest	1.83	Sangre de Cristo Mountains, alpine valley, desert, rocky crags, wilderness areas, wildlife, foothills, wildflowers, creeks
Routt National Forests	2.9	Mountain ranges, grasslands, streams, wildlife
San Juan National Forest	1.8	Hardwood forests, hills, mountain vistas, wildlife
White River National Forest	2.3	Wilderness areas, mountain peaks, lake vistas

Source: (USFS, 2013)

State and Federal Trails

Colorado maintains a network of trails recreational purposes, including hiking, biking, walking, horseback riding, skiing and snowshoeing, snowmobiling and off-road vehicle driving. These trails have aesthetic value highlighting Colorado's "natural beauty and awesome landscapes." For additional information about Colorado's trails, see "Things to Do" on the Colorado Parks & Wildlife website. (CPW, 2015i)

Designated under Section 5 of the National Trails System Act (16 U.S.C. 1241-1251, as amended), National Scenic Trails (NSTs) are defined as extended trails that "provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas though which they pass" (NPS, 2012b). There is one National Scenic Trail in Colorado, the Continental Divide National Scenic Trail (see Figure 3.1.8-4). The Continental Divide NST consists of 3,100 miles stretching from the international borders of Montana to New Mexico, 30 miles of which traverse the Rocky Mountain National Park and a variety of terrain and altitudes. (NPS, 2015j)

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, 2012b). Four National Historic Trails pass through Colorado and surrounding states: California National Historic Trail, Old Spanish National Historic Trail, Pony Express National Historic Trail and Santa Fe National Historic Trail. The Pony Express National Historic Trail was the fastest and most direct east-west communication before the invention of the telegraph. The California National Historic Trail follows the path of gold rush emigrants during the greatest migration in U.S. history along more than 1,000 miles across 10 states. (NPS, 2015b)

In addition to National Scenic and Historic Trails, the National Trails System Act authorized the designation of National Recreational Trails near urban areas by either the Secretaries of the Interior or Agriculture, depending upon the ownership of the designated land (American Trails, 2015). In Colorado there are 39 National Recreation Trails administered by the USFS, USFWS, local and state governments and non-profit organizations (National Recreation Trails, 2015).

3.1.8.6. Natural Areas

National Conservation Area

The BLM manages National Conservation Areas (NCA) designated by Congress to "conserve, protect, enhance and manage public lands for the benefit and enjoyment of present and future generations." These areas are "landscapes with exceptional natural, recreational, cultural, wildlife, aquatic, archaeological, paleontological, historical, educational, or scientific resources or value." There are three NCAs in Colorado, Dominquez-Escalante, Gunnison Gorge and McInnis Canyons. (BLM, 2015d)

National Wilderness Areas

In 1964, Congress enacted the Wilderness Act of 1964 as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. A designation as a National Wilderness Area is the highest level of conservation protection given by Congress to federal lands. This Act defined wilderness as land untouched by man and primarily affected only by the "forces of nature" and as that which "may also contain ecological, geological, or other features of scientific, education, scenic, or historical value." Over 106 million acres of federal public lands have been designated as wilderness areas. Fifty-three percent of these federal lands are in 47 national parks (44 million acres) and part of the National Park System. These designated wilderness areas are managed by the USFS, BLM, USFWS, and NPS. (NPS, 2015k)

Table 3.1.8-6: Colorado National Wilderness Areas

NWA Name	
Black Canyon of the Gunnison Wilderness	Maroon Bells-Snowmass Wilderness (map)
Black Ridge Canyons Wilderness	Mesa Verde Wilderness (map)
Buffalo Peaks Wilderness	Mount Evans Wilderness
Byers Peak Wilderness	Mount Massive Wilderness
Cache La Poudre Wilderness	Mount Sneffels Wilderness
Collegiate Peaks Wilderness	Mount Zirkel Wilderness
Comanche Peak Wilderness	Neota Wilderness
Dominguez Canyon Wilderness	Never Summer Wilderness
Eagles Nest Wilderness	Platte River Wilderness
Flat Tops Wilderness	Powderhorn Wilderness
Fossil Ridge Wilderness	Ptarmigan Peak Wilderness
Great Sand Dunes Wilderness	Raggeds Wilderness
Greenhorn Mountain Wilderness	Rawah Wilderness

NWA Name	
Gunnison Gorge Wilderness	Rocky Mountain National Park Wilderness
Hermosa Creek Wilderness	Sangre de Cristo Wilderness
Holy Cross Wilderness	Sarvis Creek Wilderness
Hunter-Fryingpan Wilderness	South San Juan Wilderness
Indian Peaks Wilderness	Spanish Peaks Wilderness
James Peak Wilderness	Uncompahgre Wilderness
La Garita Wilderness	Vasquez Peak Wilderness
Lizard Head Wilderness	Weminuche Wilderness
Lost Creek Wilderness	West Elk Wilderness

Source: (Wilderness.net, 2015)

Wilderness Study Areas

In accordance with the Federal Land Policy Management Act of 1976, local BLM offices identify "relatively undeveloped areas with special ecological, geological, educational, historical, scientific, or scenic values that may be suitable for wilderness designation." These offices are responsible for managing the areas until a formal designation as wilderness area is made. In Colorado, there are 53 Wilderness Study Areas divided among 10 field offices. (BLM, 2015e)

State Preserves

Colorado is home to nature preserves managed by both private and public stakeholders. Colorado Parks & Wildlife maintains Mueller State Park and Wildlife Area to preserve natural resources and wildlife and to provide recreation (The Nature Conservancy, 2015a). The North Star Nature Preserve is managed by Pitkin County to "provide low-impact recreation, as a much-needed wildlife corridor, and as an environmental education site" (The Nature Conservancy, 2015b). An additional 14 natural areas are preserved by the private organization, The Nature Conservancy (The Nature Conservancy, 2015c).

Rivers Designated as National or State Wild, Scenic or Recreational

National Wild, Scenic, or Recreational Rivers are those rivers designated by Congress or the Secretary of the Interior in accordance with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271-1287). These rivers have outstanding natural, cultural, and recreational values, including potential visual resources. A portion of only one river, the Cache La Poudre River, has been designated a National Wild and Scenic River in Colorado (see Figure 3.1.8-6). Colorado does not designate separate state wild, scenic, or recreational rivers.

Figure 3.1.8-5: Cache La Poudre River

Source: (USFWS, 2015c)

National Wildlife Refuges and State Wildlife Management Areas

National Wildlife Refuges (NWRs) are a network of lands and waters managed by the USFWS. These lands and waters are "set aside for the conservation, management and, where appropriate, restoration of fish, wildlife, and plant resources and their habitats" (USFWS, 2013d). There are eight NWRs in Colorado (USFWS, 2015y) (see Figure 3.1.8-3). The Arapahoe National Wildlife Refuge is the highest NWR in the lower 48 states and is located in an intermountain glacial basin (USFWS, 2015z). Visual resources within this NWR include mountain vistas, slow, meandering streams, meadows, sagebrush grasslands, sagebrush uplands, wetlands and mixed conifer forests (USFWS, 2015z).

Table 3.1.8-7: Colorado National Wildlife Refuges

NWR Name	
Alamosa NWR	Monte Vista NW
Arapaho NWR	Rocky Flats NW
Baca NWR	Rocky Mountain Arsenal NW
Brown's Park NWR	Two Ponds NW

Source: (USFWS, 2015q)

Colorado Parks and Wildlife manages almost 350 State Wildlife Management areas for the benefit of wildlife and "to offer wildlife recreation to the public" (CPW, 2015j). For additional information on wildlife refuges and management areas, see Section 11.7, Wildlife. For additional information on wildlife refuges and management areas, see Section 3.1.6.4., Wildlife.

National Natural Landmarks

National Natural Landmarks (NNLs) are sites designated by the U.S. Secretary of the Interior that "contain outstanding biological and/or geological resources, regardless of land ownership" and "are selected for their outstanding condition, illustrative value, rarity, diversity, and value to science and education" (NPS, 2014e). These landmarks may be considered visual resources or visually sensitive. In Colorado, there are 14 NNLs (Table 3.1.8-8).

Some of the natural features located within these areas include arctic tundra, titled and faulted sedimentary strata, fossil sites, and paleontological sites. (NPS, 2012c)

Figure 3.1.8-6: Hanging Lake

Source: (NPS, 2012a)

Table 3.1.8-8: Colorado National Natural Landmarks

NNL Name	
Big Spring Creek	Raton Mesa
Garden of the Gods	Roxborough State Park
Garden Park Fossil Area	Russell Lakes
Hanging Lake	Sand Creek
Indian Springs Trace Fossil	Slumgullion Earthflow
Lost Creek Scenic Area	Spanish Peaks
Morrison-Golden Fossil Areas	Summit Lake

Source: (NPS, 2012c)

3.1.8.7. Additional Areas

State and National Scenic Byways

National Scenic Byways are resources designated specifically for scenic or aesthetic areas or qualities which would be considered visual resources or visually sensitive. Colorado has 10 designated National Scenic Byways: Colorado River Headwaters Byway, Dinosaur Diamond Prehistoric Highway, Frontier Pathways Scenic and Historic Byway, Gold Belt Tour Scenic and Historic Byway, Grand Mesa Scenic and Historic Byway, Lariat Loop Scenic and Historic Byway, San Juan Skyway, Santa Fe Trail, Top of the Rockies, Trail of the Ancients, and Trail

Ridge Road/Beaver Meadow Road (see Figure 11.10.3-1 in Section 11.10 Land Use, Recreation, and Airspace) (FHWA, 2015c).

Similar to National Scenic Byways, the CDOT administers the Colorado Scenic and Historic Byways program. There are 16 State Byways, 10 of which are also designated National Scenic Byways (see Figure 3.1.8-9 and Figure 3.10.3-1 in Section 3.10 Land Use, Recreation, and Airspace and Table). The Flat Tops Trail Byway traverses land that inspired that nation's first wilderness areas and passes by Trappers Lake through ranches and small towns (see Figure 3.1.8-4) (CDOT, 2007).

Table 3.1.8-9: Colorado State Scenic and Historic Byways

State Byway Name	
Alpine Loop	Mount Evans
Cache la Poudre-North Park	Pawnee Pioneer Trails
Collegiate Peaks	Peak to Peak
Colorado River Headwaters	Santa Fe Trail
Dinosaur Diamond	San Juan Skyway
Flat Tops Trail	Silver Thread
Frontier Pathways	South Platte River Trail
Gold Belt Tour	Top of the Rockies
Grand Mesa	Tracks Across Borders
Guanella Pass	Trail of the Ancients
Highway of Legends	Trail Ridge Road/Beaver Meadow Road
Lariat Loop	Unaweep Tabeguache
Los Caminos Antiguos	West Elk Loop

Source: (CDOT, 2015e)

3.1.9. Socioeconomics

3.1.9.1. Definition of the Resource

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

The choice of socioeconomic topics and depth of their treatment depends on the relevance of potential topics to the types of federal actions under consideration. FirstNet's mission is to provide public safety broadband and interoperable emergency communications coverage throughout the nation. Relevant socioeconomic topics include population density and growth, economic activity, housing, property values, and state and local taxes. The financial arrangements for deployment and operation of the FirstNet network may have socioeconomic implications. Section 1.1 frames some of the public expenditure and public revenue considerations specific to FirstNet; however this is not intended to be either descriptive or prescriptive of FirstNet's financial model or anticipated total expenditures and revenues associated with the deployment of the Nationwide Public Safety Broadband Network (NPSBN). This socioeconomics section provides some additional, broad context, including data and discussion of state and local government revenue sources that FirstNet may affect.

Environmental justice is a related topic that specifically addresses the presence of minority populations (defined by race and Hispanic ethnicity) and low-income populations, in order to give special attention to potential impacts on those populations, per Executive Order 12898 (see Section 1.8, Overview of Relevant Federal Laws and Executive Orders). This PEIS addresses environmental justice in a separate section (Section 3.1.10). This PEIS also addresses the following topics, sometimes included within socioeconomics, in separate sections: land use, recreation, and airspace (Section 3.1.7, Land Use, Recreation, and Airspace), infrastructure (Section 3.1.1, Infrastructure), and aesthetic considerations (Section 3.1.8, Visual Resources).

Wherever possible, this section draws on nationwide datasets from federal sources such as the U.S. Census Bureau[122] (Census Bureau) and U.S. Bureau of Labor Statistics (BLS). This ensures consistency of data and analyses across the states examined in this PEIS. In all cases, this section uses the most recent data available for each geography at the time of writing. At the county, state, region, and United States levels, the data are typically for 2013 or 2014. For smaller geographic areas, this section uses data from the Census Bureau's American Community Survey (ACS). The ACS is the Census Bureau's flagship demographic estimates program for

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

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.

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

3.1.9.2. Specific Regulatory Considerations

Research for this section did not identify any specific state, local, or tribal laws or regulations that are directly relevant to socioeconomics for this PEIS.

3.1.9.3. Communities and Populations

This section discusses the population and major communities of Colorado (CO). It includes the following topics:

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

Statewide Population and Population Growth

Table 3.1.9-1 presents the 2015 estimated population and 2010 population density of Colorado in comparison to the Central region[123] and the nation. The estimated population of Colorado in 2015 was 5,456,574. The population density was 49 persons per square mile (sq. mi.), which is lower than the population density of both the region (66 persons/sq. mi.) and the nation (90 persons/sq. mi.). In 2015, Colorado was the 22nd largest state by estimated population among the 50 states and the District of Columbia, eighth largest by land area, and had the 38th greatest population density (U.S. Census Bureau, 2015a; U.S. Census Bureau, 2015l).

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

Geography	Land Area (sq. mi.)	Estimated Population 2014	Population Density 2010 (persons/sq. mi.)
Colorado	103,642	5,456,574	49
Central Region	1,178,973	77,651,608	66
United States	3,531,905	321,418,820	90

Sources: (U.S. Census Bureau, 2015a; U.S. Census Bureau, 2015l)

Population growth is an important aspect for this PEIS given FirstNet's mission. Table 3.1.9-2 presents the population growth trends of Colorado from 2000 to 2014 in comparison to the

[123] The Central region is comprised of the states of Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Montana, Nebraska, North Dakota, Ohio, South Dakota, Utah, Wisconsin, and Wyoming. Throughout the socioeconomics section, figures for the Central region represent the sum of the values for all states in the region, or an average for the region based on summing the component parameters. For instance, the population density of the Central region is the sum of the populations of all its states, divided by the sum of the land areas of all its states.

Central region and the nation. The state's annual growth rate in the 2010 to 2014 period (1.59 percent) was nearly the same as in the 2000 to 2010 period (1.58 percent). The growth rate of Colorado in both periods was substantially higher than the growth rates of the region (0.45-0.53 percent) and the nation (0.81-0.93 percent).

Table 3.1.9-2: Recent Population Growth of Colorado

Geography	Estimated Population			Numerical Estimated Population Change		Rate of Estimated Population Change (AARC)[a]	
	2000	2010	2014	2000 to 2010	2010 to 2014	2000 to 2010	2010 to 2014
Colorado	4,301,261	5,029,196	5,355,866	727,935	326,670	1.58%	1.59%
Central Region	72,323,183	76,273,123	77,651,608	3,949,940	1,378,485	0.53%	0.45%
United States	281,421,906	308,745,538	318,857,056	27,323,632	10,111,518	0.93%	0.81%

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

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

Demographers prepare future estimated population projections using various population growth modeling methodologies. For this nationwide PEIS, it is important to use estimated population projections that apply the same methodology across the nation. It is also useful to consider projections that use different methodologies, since no methodology is a perfect predictor of the future. The Census Bureau does not prepare population projections for the states. Therefore, Table 3.1.9-3 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. 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 Colorado's estimated population will increase by 930,845 people, or 17.4 percent, from 2014 to 2030. This reflects an average annual projected growth rate of 1.01 percent, which is less than the historical growth rate from 2010 to 2014 of 1.59 percent. The projected growth rate of the state is higher than that of the region (0.60 percent) and the nation (0.80 percent).

Table 3.1.9-3: Projected Estimated Population Growth of Colorado

Geography	Estimated Population 2014	Projected 2030 Estimated Population			Change Based on Average Projection		
		UVA Weldon Cooper Center Projection	Proximity One Projection	Average Projection	Numerical Change 2014 to 2030	Percent Change 2014 to 2030	Rate of Change (AARC) 2014 to 2030
Colorado	5,355,866	6,409,771	6,163,650	6,286,711	930,845	17.4%	1.01%
Central Region	77,651,608	83,545,838	87,372,952	85,459,395	7,807,787	10.1%	0.60%
United States	318,857,056	360,978,449	363,686,916	362,332,683	43,475,627	13.6%	0.80%

Sources: (U.S. Census Bureau, 2015a; ProximityOne, 2015; UVA Weldon Cooper Center, 2015)

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

Population Distribution and Communities

Figure 3.1.9-1 presents the distribution and relative density of the estimated population of Colorado. Each brown dot represents 500 people, and massing of dots indicates areas of higher population density – therefore, areas that are solid in color are particularly high in population density. The map uses ACS estimates based on samples taken from 2009 to 2013 (U.S. Census Bureau, 2015d).

This map also presents the 10 largest population concentrations in the state, outlined in purple. These population concentrations reflect contiguous, densely developed areas as defined by the Census Bureau based on the 2010 census (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015y). 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. All but one of the 10 population concentrations fall within a relatively limited spatial area in the central and north central portions of the state. Most of the remainder of the state is sparsely populated, with scattered smaller communities.

Table 3.1.9-4 provides the populations of the 10 largest population concentrations in Colorado, based on the 2010 census. It also shows the changes in population for these areas between the 2000 and 2010 censuses.[124] In 2010, the largest population concentration by far was the Denver/Aurora area, which had over 2.3 million people. The Colorado Springs area was the only other area with a population over 500,000. Colorado had five areas with populations between

[124] 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.

100,000 and 500,000, and three areas with populations under 100,000. The smallest of these 10 population concentrations was the Cañon City area, with a 2010 population of 27,139. The fastest growing area, by average annual rate of change from 2000 to 2010, was the Grand Junction area, with an annual growth rate of 3.33 percent. Seven other areas had growth rates over 1.00 percent. The population concentrations with the lowest growth rates were the Boulder (0.20 percent) and Cañon City (0.30 percent) areas.

Table 3.1.9-4 also shows that the top 10 population concentrations in Colorado accounted for over 77 percent of the state's population in 2010. Further, population growth in the 10 areas from 2000 to 2010 amounted to 89.8 percent of the entire state's growth. These figures indicate that the population within these 10 areas is growing at a faster rate than the population in the remainder of the state.

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

Area	Population				Population Change 2000 to 2010	
	2000	2010	2009–2013	Rank in 2010	Numerical Change	Rate (AARC)
Boulder	112,299	114,591	117,944	7	2,292	0.20%
Cañon City	26,332	27,139	26,090	10	807	0.30%
Colorado Springs	466,122	559,409	570,003	2	93,287	1.84%
Denver/Aurora	1,984,887	2,374,203	2,431,553	1	389,316	1.81%
Fort Collins	206,633	264,465	269,140	3	57,832	2.50%
Grand Junction	92,362	128,124	129,341	5	35,762	3.33%
Greeley	93,879	117,825	121,123	6	23,946	2.30%
Lafayette/Louisville/Erie	60,387	79,407	81,371	9	19,020	2.78%
Longmont	72,929	90,897	92,352	8	17,968	2.23%
Pueblo	123,351	136,550	139,088	4	13,199	1.02%
Total for Top 10 Population Concentrations	**3,239,181**	**3,892,610**	**3,978,005**	**NA**	**653,429**	**1.85%**
Colorado (statewide)	**4,301,261**	**5,029,196**	**5,119,329**	**NA**	**727,935**	**1.58%**
Top 10 Total as Percentage of State	**75.3%**	**77.4%**	**77.7%**	**NA**	**89.8%**	**NA**

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

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

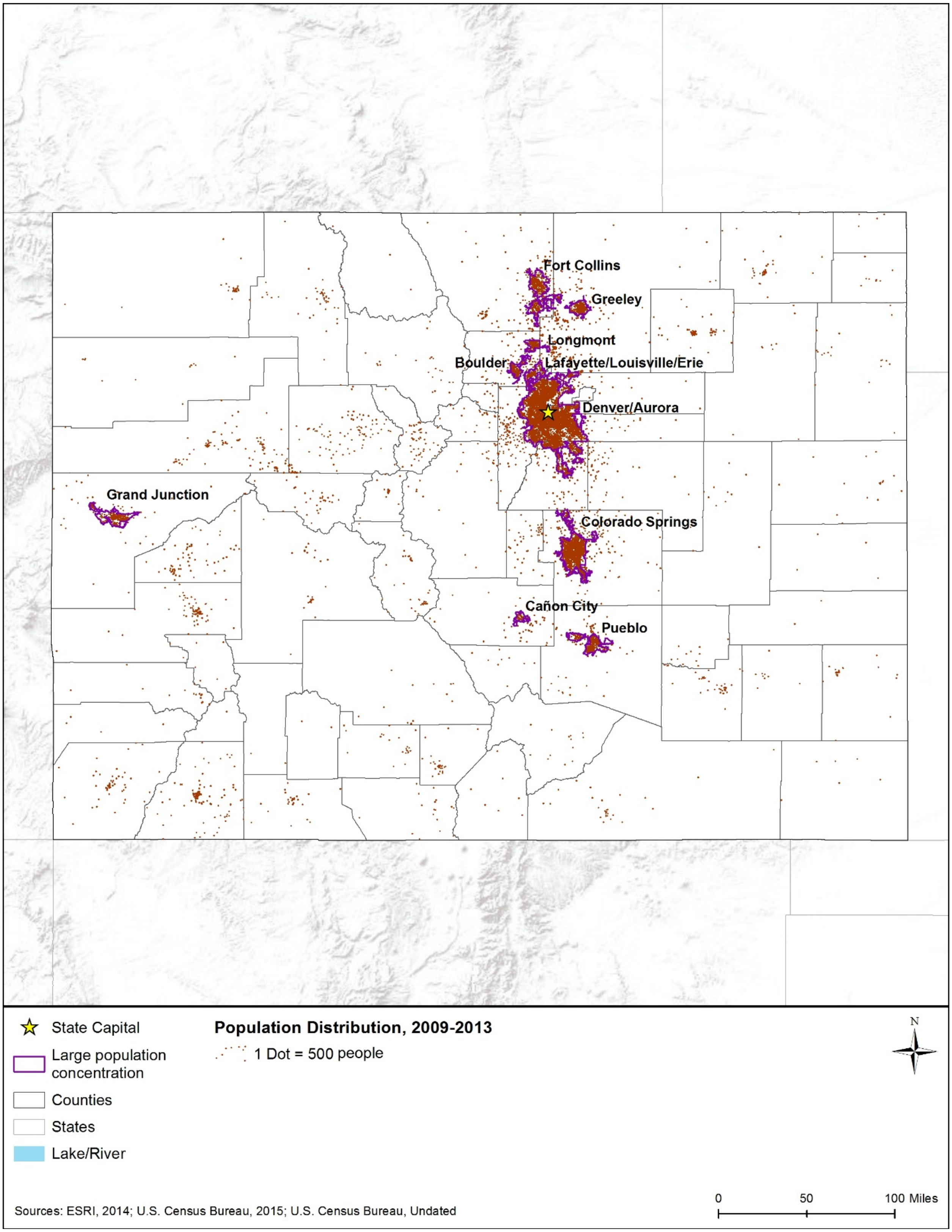

Figure 3.1.9-1: Estimated Population Distribution in Colorado, 2009–2013

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

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

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

Social institutions – educational, family, political, public service, military, and religious – are present throughout the state. The institutions most relevant to FirstNet projects are public services such as medical and emergency medical services and facilities. This PEIS addresses public services in Section 3.1.1, Infrastructure. Project-level NEPA analyses may need to examine other institutions, depending on specific locations and specific types of actions.

Economic Activity

Table 3.1.9-5 compares several economic indicators for Colorado to the Central region and the nation. The table presents two indicators of income[125] – per capita and median household – as income is a good measure of general economic health of a region.

Per capita income is total income divided by the total population. As a mathematical average, the very high incomes of a relatively small number of people tend to bias per capita income figures upwards. Nonetheless, per capita income is useful as an indicator of the relative income level across two or more areas. As shown in Table 3.1.9-5, the per capita income in Colorado in 2013 ($31,421) was $3,893 higher than that of the region ($27,528), and $3,237 higher than that of the nation ($28,184).

Household income is a useful measure, and often used instead of family income, because in modern society there are many single-person households and households composed of non-related individuals. Median household income (MHI) is the income at which half of all households have higher income, and half have lower income. Table 3.1.9-5 shows that in 2013, the MHI in Colorado ($58,942) was $6,897 higher than that of the region ($52,045), and $6,692 higher than that of the nation ($52,250).

Employment status is a key socioeconomic parameter because employment is essential to the income of a large portion of the adult population. The federal government calculates the unemployment rate as the number of unemployed individuals who are looking for work divided by the total number of individuals in the labor force. Table 3.1.9-5 compares the unemployment

[125] The Census Bureau defines income as follows: "'Total income' is the sum of the amounts reported separately for wage or salary income; net self-employment income; interest, dividends, or net rental or royalty income or income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income. Receipts from the following sources are not included as income: capital gains, money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income "in kind" from food stamps, public housing subsidies, medical care, employer contributions for individuals, etc.; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump-sum receipts." (U.S. Census Bureau, 2015h)

rate in Colorado to the Central region and the nation. In 2014, Colorado's statewide unemployment rate of 5.0 percent was lower than the rate for the region (5.7 percent) and the nation (6.2 percent)[126].

Table 3.1.9-5: Selected Economic Indicators for Colorado

Geography	Per Capita Income 2013	Median Household Income 2013	Average Annual Unemployment Rate 2014
Colorado	$31,421	$58,942	5.0%
Central Region	$27,528	$52,045	5.7%
United States	$28,184	$52,250	6.2%

Sources: (U.S. Bureau of Labor Statistics, 2015; U.S. Census Bureau, 2015i; U.S. Census Bureau, 2015j; U.S. Census Bureau, 2015k)

Figure 3.1.9-1 and Figure 3.1.9-3 show how MHI in 2013 (U.S. Census Bureau, 2015i) and unemployment in 2014 (U.S. Bureau of Labor Statistics, 2015) varied by county across the state. These maps also incorporate the same population concentration data as Figure 3.1.9-1 (U.S. Census Bureau, 2012a; U.S. Census Bureau, 2015y). Following these two maps, Table 3.1.9-6 presents MHI and unemployment for the 10 largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to those on the maps. Nonetheless, both the maps and the table help portray differences in income and unemployment across Colorado. Figure 3.1.9-2 shows that, in general, counties with a MHI above the national median were located in the central, north central, and northwest portions of the state, as well as the southwest corner of the state. Most of the remainder of the state had MHI levels below the national average. The counties with the lowest MHI were located in the south central and southeast portions of the state. Table 3.1.9-6 shows that MHI in the Boulder, Denver/Aurora, Lafayette/Louisville/Erie, and Longmont areas was above the state average. MHI in all other population concentrations was below the state average. MHI was lowest in the Cañon City and Pueblo areas, in both cases considerably below the state average. Cañon City is also the smallest of the areas shown in the table.

Figure 3.1.9-3 presents variations in the 2014 unemployment rate across the state, by county. It shows that counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state. However, many of the counties in the south central portion of the state had unemployment rates above the national average. When comparing unemployment in the population concentrations to the state average (Table 3.1.9-6), the Colorado Springs, Grand Junction, Greeley, Longmont, and Pueblo areas all had 2009–2013 unemployment rates that were higher than the state average. The unemployment rate in the Pueblo area (12.1 percent) was particularly high.

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

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

By industry, Colorado has a mixed economic base and some notable figures in the table are as follows. Colorado in 2013 had considerably lower percentages of persons working in “manufacturing” and in “educational services, and health care and social assistance” than did the region or the nation. It had a considerably higher percentage of workers in “professional, scientific, management, administrative, and waste management services” than the region or nation. In all other industries, Colorado had relatively similar percentages of employment (within two percentage points) to the region and nation.

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

Area	Median Household Income	Average Annual Unemployment Rate
Boulder	$59,715	7.7%
Cañon City	$38,615	7.9%
Colorado Springs	$55,303	9.6%
Denver/Aurora	$61,409	8.4%
Fort Collins	$56,548	8.3%
Grand Junction	$47,758	9.0%
Greeley	$45,883	10.4%
Lafayette/Louisville/Erie	$87,611	5.8%
Longmont	$59,207	8.7%
Pueblo	$39,773	12.1%
Colorado (statewide)	$58,433	8.5%

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

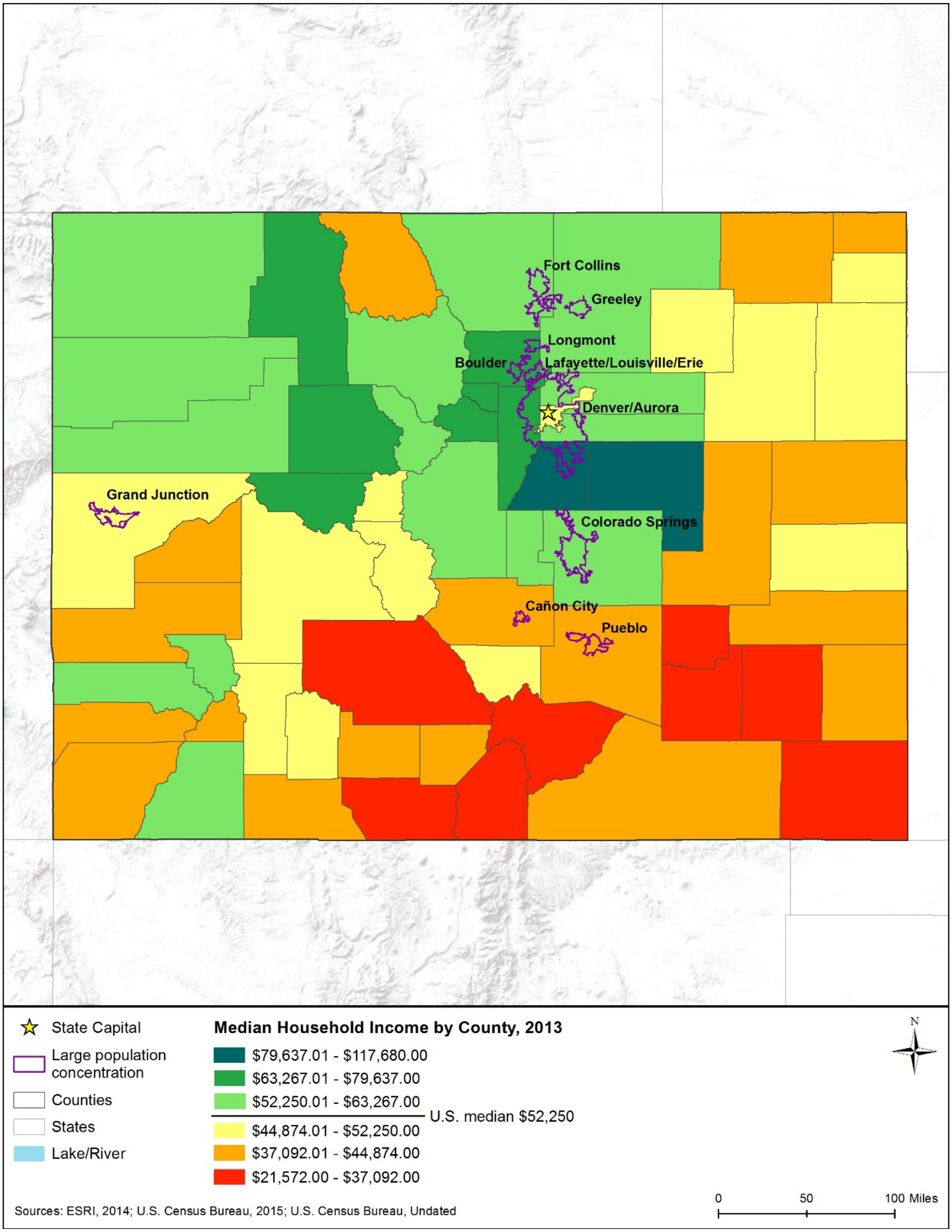

Figure 3.1.9-2: Median Household Income in Colorado, by County, 2013

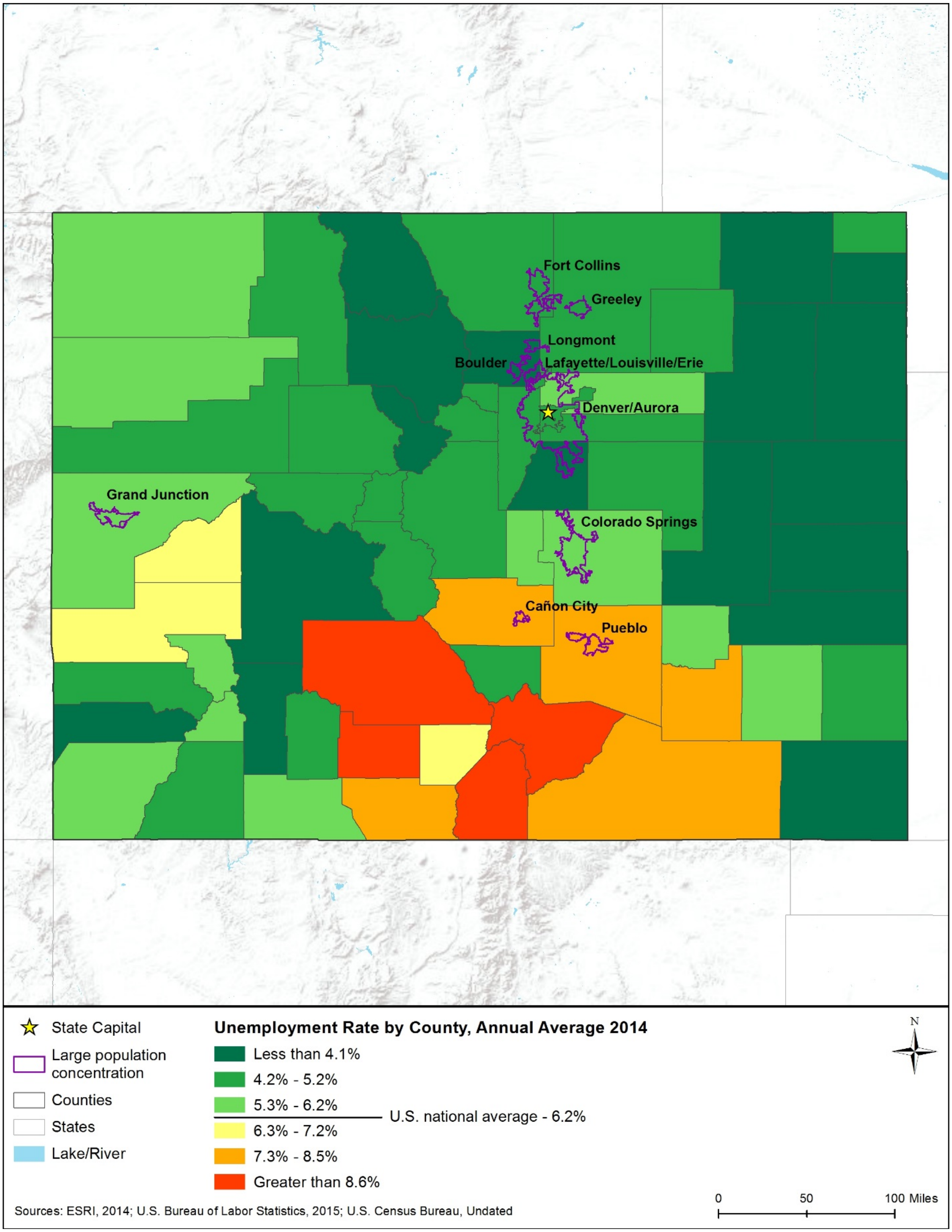

Figure 3.1.9-3: Unemployment Rates in Colorado, by County, 2014

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

Class of Worker and Industry	Colorado	Central Region	United States
Civilian Employed Population 16 Years and Over	2,593,798	36,789,905	145,128,676
Percentage by Class of Worker			
Private wage and salary workers	79.5%	81.7%	79.7%
Government workers	13.8%	12.8%	14.1%
Self-employed in own not incorporated business workers	6.4%	5.3%	6.0%
Unpaid family workers	0.2%	0.2%	0.2%
Percentage by Industry			
Agriculture, forestry, fishing and hunting, and mining	2.6%	2.2%	2.0%
Construction	7.2%	5.6%	6.2%
Manufacturing	7.1%	14.0%	10.5%
Wholesale trade	2.6%	2.7%	2.7%
Retail trade	11.3%	11.5%	11.6%
Transportation and warehousing, and utilities	4.6%	4.9%	4.9%
Information	3.0%	1.9%	2.1%
Finance and insurance, and real estate and rental and leasing	7.0%	6.5%	6.6%
Professional, scientific, management, administrative, and waste management services	13.6%	9.7%	11.1%
Educational services, and health care and social assistance	20.2%	23.4%	23.0%
Arts, entertainment, and recreation, and accommodation and food services	11.0%	9.1%	9.7%
Other services, except public administration	5.0%	4.6%	5.0%
Public administration	4.8%	3.9%	4.7%

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

Table 3.1.9-8 presents employment shares for selected industries for the 10 largest population concentrations in the state. The table reflects survey data taken by the Census Bureau from 2009 to 2013. Thus, its figures for the state are slightly different from those in Table 3.1.9-7 for 2013.

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

Area	Construction	Transportation and Warehousing, and Utilities	Professional, Scientific, Management, Administrative and Waste Management Services
Boulder	3.0%	12.72%	20.0%
Cañon City	7.7%	4.7%	7.7%
Colorado Springs	6.5%	3.9%	12.9%
Denver/Aurora	7.0%	5.0%	14.7%
Fort Collins	6.2%	3.0%	12.4%
Grand Junction	6.6%	5.7%	7.9%

Area	Construction	Transportation and Warehousing, and Utilities	Professional, Scientific, Management, Administrative and Waste Management Services
Greeley	7.8%	3.8%	9.2%
Lafayette/ Louisville/Erie	4.2%	2.4%	20.7%
Longmont	6.6%	2.9%	17.0%
Pueblo	7.8%	4.2%	7.8%
Colorado (statewide)	7.4%	4.6%	13.2%

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

Housing

The housing stock is an important socioeconomic component of communities. The type, availability, and cost of housing in an area reflect economic conditions and affect quality of life. Table 3.1.9-9 compares Colorado to the Central region and nation on several common housing indicators.

As shown in this table, in 2013 Colorado had a higher percentage of housing units that were occupied (89.1 percent) than the region (88.4 percent) or nation (87.6 percent). Of the occupied units, Colorado had a lower percentage of owner-occupied units (64.5 percent) than the region (67.6 percent) and a higher percentage than the nation (63.5 percent). Similarly, the percentage of detached single-unit housing (also known as single-family homes) in Colorado in 2013 (63.1 percent) was lower than the region (67.7 percent), but higher than the nation (61.5 percent). The homeowner vacancy rate in Colorado (1.4 percent) was lower than the rate for the region (1.8 percent) and nation (1.9 percent). This rate reflects, “vacant units that are ‘for sale only’” (U.S. Census Bureau, 2015h). The vacancy rate among rental units was lower in Colorado (5.3 percent) than in the region (6.0 percent) or nation (6.5 percent).

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

Geography	Total Housing Units	Housing Occupancy & Tenure				Units in Structure
		Occupied Housing	Owner-Occupied	Homeowner Vacancy Rate	Rental Vacancy Rate	1-Unit, Detached
Colorado	2,247,291	89.1%	64.5%	1.4%	5.3%	63.1%
Central Region	33,580,411	88.4%	67.6%	1.8%	6.0%	67.7%
United States	132,808,137	87.6%	63.5%	1.9%	6.5%	61.5%

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

Table 3.1.9-10 provides housing indicators for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does present variation in these indicators for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Table 3.1.9-10 shows that during this period, the percentage of occupied housing units was higher for all 10 population concentrations than the state percentage (89.0 percent).

Table 3.1.9-10: Selected Housing Indicators for the 10 Largest Population Concentrations in Colorado, 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
Boulder	51,547	94.8%	53.1%	1.5%	3.0%	45.7%
Cañon City	10,566	91.9%	65.7%	1.6%	2.4%	70.2%
Colorado Springs	231,158	93.5%	61.7%	2.0%	5.5%	64.3%
Denver/Aurora	1,003,425	94.2%	62.5%	1.7%	5.4%	57.2%
Fort Collins	111,261	95.4%	62.4%	1.2%	3.2%	62.7%
Grand Junction	54,498	94.5%	69.2%	1.2%	3.0%	69.6%
Greeley	45,202	92.8%	57.8%	1.4%	7.6%	59.7%
Lafayette/Louisville/Erie	32,448	97.0%	75.8%	0.5%	3.9%	71.5%
Longmont	36,838	95.8%	63.2%	1.4%	3.1%	63.7%
Pueblo	59,978	91.1%	62.7%	2.6%	6.9%	74.2%
Colorado (statewide)	2,222,782	89.0%	65.4%	2.0%	6.1%	62.9%

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

Property Values

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

Table 3.1.9-11 provides indicators of residential property values for Colorado and compares these values to values for the Central 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, 2015h).

The table shows that the median value of owner-occupied units in Colorado in 2013 ($240,500) was considerably higher than the corresponding values for the Central region ($151,200) and the nation ($173,900).

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

Geography	Median Value of Owner-Occupied Units
Colorado	$240,500
Central Region	$151,200
United States	$173,900

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

Table 3.1.9-12 presents residential property values for the largest population concentrations in the state. The table reflects survey data taken from 2009 to 2013. Thus, its figures are not directly comparable to the more recent data in the previous table. However, it does show variation in property values for population concentrations across the state and compared to the state average for the 2009 to 2013 period. Four of the 10 areas had median values higher than the state median value ($236,200), including the Boulder, Denver/Aurora, Lafayette/Louisville/Erie, and Longmont areas. Values were particularly high in the Boulder ($473,500) and Lafayette/Louisville/Erie ($347,200) areas. The Cañon City, Greeley, and Pueblo areas had the lowest median values, ranging from $129,300 to $159,500. These three areas also had the lowest median household incomes (Table 3.1.9-6).

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

Area	Median Value of Owner-Occupied Units
Boulder	$473,500
Cañon City	$154,100
Colorado Springs	$206,400
Denver/Aurora	$241,300
Fort Collins	$234,800
Grand Junction	$198,300
Greeley	$159,500
Lafayette/Louisville/Erie	$347,200
Longmont	$239,500
Pueblo	$129,300
Colorado (statewide)	$236,200

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

Government Revenues

State and local governments obtain revenues from many sources. FirstNet projects may affect flows of revenue sources between different levels of government due to program financing and intergovernmental agreements for system development and operation. Public utility taxes[127] 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). These service providers may obtain new taxable revenues from operation of components of the public safety broadband network. These revenue streams are typically highly localized and therefore are best considered in the deployment phase of FirstNet.

Table 3.1.9-13 presents total and selected state and local government revenue sources as reported by the Census Bureau's 2012 Census of Governments. It provides both total dollar figures (in millions of dollars) and figures per capita (in dollars), based on total population for each geography. The per capita figures are particularly useful in comparing the importance of certain revenue sources in the state relative to other states in the region and the nation. State and local governments may obtain some additional revenues related to telecommunications infrastructure.

General and selective sales taxes may change, reflecting expenditures during system development and maintenance.

Table 3.1.9-13 shows that the Colorado state government received less, while Colorado local governments received more, total revenue in 2012 on a per capita basis than their counterpart governments in the region and nation. Additionally, the Colorado state government had lower levels of intergovernmental revenue,[128] from the federal government, but local governments had higher levels of federal intergovernmental revenue, in comparison to counterparts in the region and nation. Similarly, for nearly every type of tax revenue listed, the Colorado state government obtained lower revenues per capita than state governments in the region and nation. (Notably, the state government reported no revenue from property taxes and minimal revenue from public utility taxes). The only exception to this pattern was for individual income taxes; Colorado obtained somewhat higher revenue per capita from individual income taxes than did counterparts in the nation. In contrast, for most revenue types, Colorado local governments received higher revenues on a per capita basis than counterparts in the region did, but lower per capita revenues than counterparts in the nation did. Exceptions to this pattern included individual and corporate income taxes; Colorado local governments received no revenues from these two sources. Additionally, Colorado local governments received considerably higher per capita revenue from general sales taxes than did counterparts in both the region and the nation.

[127] 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).
[128] Intergovernmental revenues are those revenues received from the federal government or other government entities such as shared taxes, grants, or loans and advances.

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

Type of Revenue	Colorado		Region		United States	
	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount	State Govt. Amount	Local Govt. Amount
Total Revenue ($M)	$25,688	$27,739	$463,192	$231,980	$1,907,027	$1,615,194
Per capita	$4,952	$5,347	$6,020	$3,015	$6,075	$5,145
Intergovernmental from Federal ($M)	$6,311	$1,335	$125,394	$9,383	$514,139	$70,360
Per capita	$1,216	$257	$1,630	$122	$1,638	$224
Intergovernmental from State ($M)	$0	$5,920	$0	$76,288	$0	$469,147
Per capita	$0	$1,141	$0	$992	$0	$1,495
Intergovernmental from Local ($M)	$86	$0	$2,721	$0	$19,518	$0[a]
Per capita	$16	$0	$35	$0	$62	$0
Property Taxes ($M)	$0	$6,951	$3,626	$61,015	$13,111	$432,989
Per capita	$0	$1,340	$47	$793	$42	$1,379
General Sales Taxes ($M)	$2,302	$3,131	$58,236	$6,920	$245,446	$69,350
Per capita	$444	$604	$757	$90	$782	$221
Selective Sales Taxes ($M)	$1,788	$379	$33,313	$2,191	$133,098	$28,553
Per capita	$345	$73	$433	$28	$424	$91
Public Utilities Taxes ($M)	$12	$147	$3,627	$1,153	$14,564	$14,105
Per capita	$2	$28	$47	$15	$46	$45
Individual Income Taxes ($M)	$4,876	$0	$72,545	$5,148	$280,693	$26,642
Per capita	$940	$0	$943	$67	$894	$85
Corporate Income Taxes ($M)	$492	$0	$9,649	$310	$41,821	$7,210
Per capita	$95	$0	$125	$4	$133	$23

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

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

3.1.10. Environmental Justice

3.1.10.1. Definition of the Resource

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, issued in 1994, sets out principles of environmental justice and requirements that federal agencies should follow to comply with the EO (see Section 1.8.11, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). The fundamental principle of environmental justice is “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies” (USEPA, 2016b) Under the EO, each federal agency must “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Executive Office of the President, 1994). In response to the EO, the Department of Commerce developed an Environmental Justice Strategy in 1995, and published an updated strategy in 2013 (U.S. Department of Commerce, 2013).

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

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

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

3.1.10.2. Specific Regulatory Considerations

The CDPHE has an internal regulatory review policy that requires regulators to identify and address "implications for health equity and environmental justice considerations" in the rulemaking process (CDPHE, 2015m). To assist regulators in implementing this policy, CDPHE has developed associated guidance documents (CDPHE, 2015m).

CDPHE also recently developed a plan for implementing its strategic priorities for fiscal year 2015-2016. One of the CDHPE's priorities is to "promote health equity and environmental justice" (CDPHE, 2015n). In accordance with this priority, CDPHE's implementation plan includes a number of related goals and activities, such as building language services, improving engagement with disadvantaged populations, and augmenting internal staff knowledge of environmental justice through training (CDPHE, 2015n).

3.1.10.3. Environmental Setting: Minority and Low-Income Populations

Table 3.1.10-1 presents 2013 data on the composition of Colorado's estimated population by race and by Hispanic origin. In general, the state's estimated populations of individuals who identify as one of the minority races listed comprise percentages that are lower than or similar to percentages for the Central region or nation. The state's population has a higher percentage of individuals who identify as Two or More Races (3.6 percent) than the populations of the Central region (2.5 percent) and the nation (3.0 percent). Colorado also has a higher percentage of individuals who identify as Some Other Race (4.8 percent) compared to the Central region (2.4 percent). The state's estimated population of persons identifying as White (83.8 percent) is larger than that of the Central region (82.2 percent) and considerably larger than that of the nation (73.7 percent).

The percentage of the estimated population in Colorado that identifies as Hispanic (21.0 percent) is substantially higher than in the Central region (8.5 percent), and somewhat higher than in the nation (17.1 percent). Hispanic origin is a different category than race; persons of any race may identify as also being of Hispanic origin.

The category All Minorities consists of all persons who consider themselves Hispanic or of any race other than White. Colorado's All Minorities estimated population percentage (30.9 percent) is higher than that of the Central region (23.3 percent), and lower than that of the nation (37.6 percent).

Table 3.1.10-2 presents the percentage of the estimated population living in poverty in 2013, for the state, region, and nation. The figure for Colorado (13.0 percent) is lower than that for the Central region (14.7 percent) and the nation (15.8 percent).

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

Geography	Total Estimated Population	Race							Hispanic	All Minorities
		White	Black/ African Am	Am. Indian/ Alaska Native	Asian	Native Hawaiian /Pacific Islander	Some Other Race	Two or More Races		
Colorado	5,268,367	83.8%	4.0%	0.8%	2.9%	0.2%	4.8%	3.6%	21.0%	30.9%
Central Region	77,314,952	82.2%	9.3%	0.7%	2.8%	0.1%	2.4%	2.5%	8.5%	23.3%
United States	316,128,839	73.7%	12.6%	0.8%	5.1%	0.2%	4.7%	3.0%	17.1%	37.6%

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

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

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

Geography	Percent Below Poverty Level
Colorado	13.0%
Central Region	14.7%
United States	15.8%

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

3.1.10.4. Environmental Justice Screening Results

Analysis of environmental justice in a NEPA document typically begins by identifying potential environmental justice populations in the project area. Appendix D, Environmental Justice Methodology, presents the methodology used in this PEIS to screen each state for the presence of potential environmental justice populations. The methodology builds on CEQ guidance and best practices used for environmental justice analysis. It uses data at the census-block group level; block groups are the smallest geographic units for which regularly updated socioeconomic data are readily available at the time of writing. Figure 3.1.10-1 visually portrays the results of the environmental justice population screening analysis for Colorado. The analysis used block group data from the Census Bureau's American Community Survey 2009-2013 5-Year Estimates (U.S. Census Bureau, 2015x; U.S. Census Bureau, 2015t; U.S. Census Bureau, 2015u; U.S. Census Bureau, 2015v) and Census Bureau urban classification data (U.S. Census Bureau, 2015y; U.S. Census Bureau, 2012a). Figure 3.1.10-1 shows that Colorado 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. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state. One notable pattern of distribution is that nearly all block groups in the southeastern part of the state are categorized as high or moderate potential for environmental justice populations; there are very few low potential areas in this part of Colorado.

It is important to understand how the data behind Figure 3.1.10-1 affect the visual impact of this map. Block groups have similar populations (hundreds to a few thousand individuals) regardless of population density. In sparsely populated areas, a single block group may cover tens or even hundreds of square miles, while in densely populated areas, block groups each cover much less than a single square mile. Thus, while large portions of the state outside the areas defined as large population concentrations show moderate or high potential for environmental justice populations, these low density areas reflect modest numbers of minority or low-income individuals compared to the potential environmental justice populations within densely populated areas. The overall effect of this relative density phenomenon is that the map visually shows large areas of the state having environmental justice potential, but this over-represents the presence of environmental justice populations.

It is also very important to note that 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.

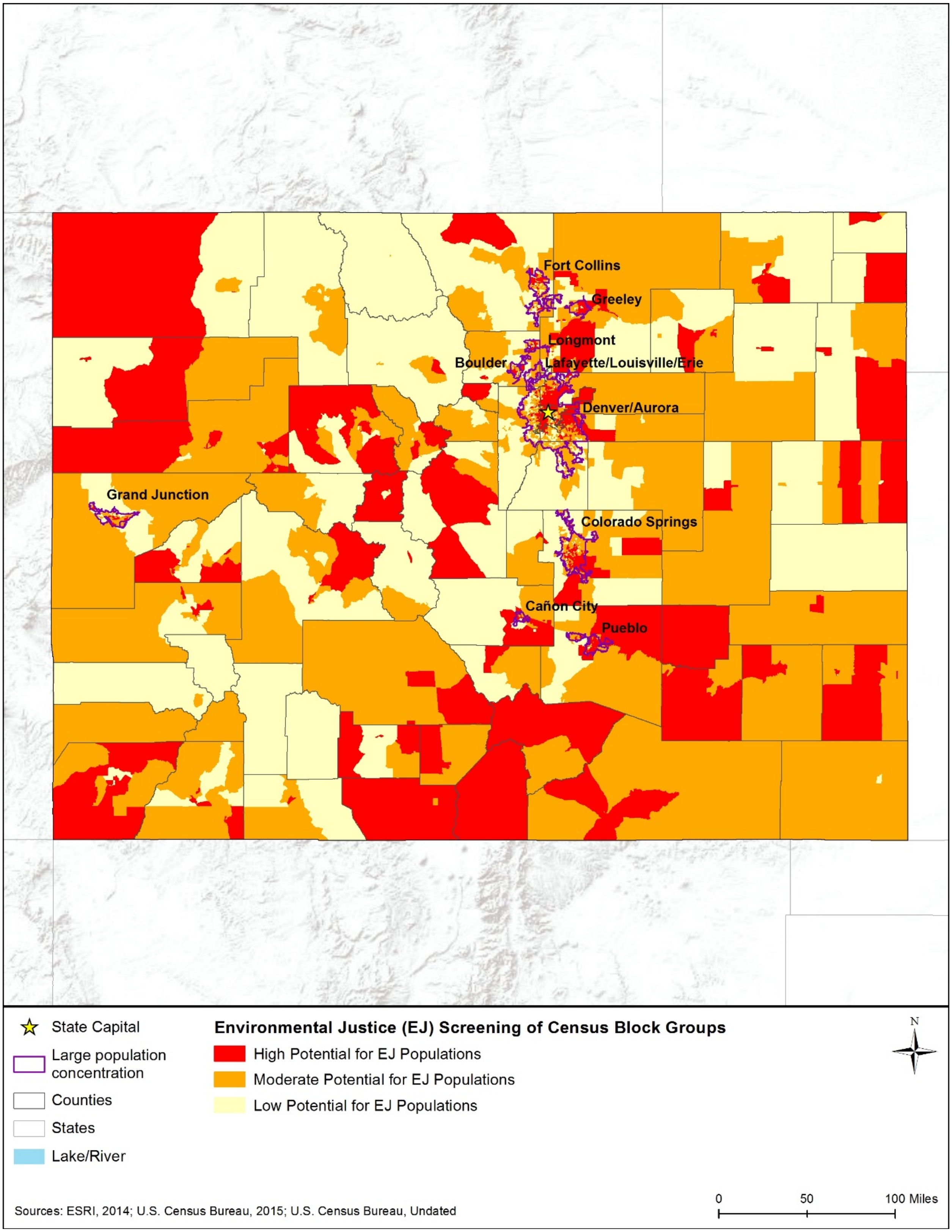

Figure 3.1.10-1: Potential for Environmental Justice Populations in Colorado, 2009–2013

This map also does not indicate whether FirstNet projects would have actual impacts on environmental justice populations. An environmental justice effect on minority or low-income populations only occurs if the effect is harmful, significant (according to NEPA criteria), and “appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group” (CEQ, 1997). The Environmental Consequences section (Section 3.2.10) addresses the potential for disproportionately high and adverse environmental or human health impacts on environmental justice populations.

3.1.11. Cultural Resources

3.1.11.1. Definition of Resource

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

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

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

- Statutory language and implementing regulations for Section 106 of NHPA, as amended, formerly 16 U.S.C. 470a(d)(6)(A) (now 54 U.S.C. 306131(b)) and 36 CFR 800.16(l)(1);
- Statutory language and Implementing regulations for the Archaeological Resources Protection Act of 1979 (ARPA), 16 U.S.C. 470cc(c) and 43 CFR 7.3(a);
- Statutory language and implementing regulations for the Native American Graves Protection and Repatriation Act (NAGPRA), 25 U.S.C. 3001(3)(D) and 43 CFR 10.2(d);
- NPS’s program support of public and private efforts to identify, evaluate, and protect America's historic and archeological resources (NPS, 2015h); and
- Advisory Council on Historic Preservation's (ACHP) guidance for protection and preservation of sites and artifacts with traditional religious and cultural importance to a Indian tribes or Native Hawaiian organizations (Advisory Council on Historic Preservation, 2004)*;*

3.1.11.2. 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, ARPA, and NAGPRA. Appendix C, Environmental Laws and Regulations, summarizes these pertinent federal laws. Colorado has a state statute that is similar to the NHPA (refer to Table 3.1.11-1). However, federal statues supersede this law. While federal agencies may take into account compatible state laws and regulations, their actions that are subject to federal environmental review under NEPA and NHPA are not subject to compliance with such state laws and regulations.

Table 3.1.11-1: Relevant Colorado Cultural Resources Laws and Regulations

State Law/Regulation	Agency	Applicability
Register of Historic Places Statute (CRS 24-80.1)	Colorado State Historic Preservation Office (SHPO)	This Act mirrors the NHPA for state actions, requiring agencies to consult with SHPO regarding potential impacts to historic properties.

3.1.11.3. Cultural and Natural Settings

Human beings have inhabited the state of Colorado for some 16,000 years (USFWS, 2002d). The majority of Colorado's early human habitation evidence comes from the study of archeological sites of pre-European contact and historic populations. In addition to the hundreds of archaeological sites listed in the state's inventory, there are 89 archaeological site listed on the NRHP: 29 are historic; 47 are prehistoric; and 13 have both historical and prehistoric provenance (NPS, 2014f).

Archaeologists typically divide large study areas into regions. As shown in Figure 3.1.11-1, Colorado occupies three Land Resource regions: Interior Plains, Intermontane Plateau, and Rocky Mountain System. The regions are divided further into five major Land Resource areas: Colorado Plateaus, Great Plains, Middle Rocky Mountains, Southern Rock Mountains, and Wyoming Basin. Each of these regions and/or land resource areas pose unique challenges when assessing the cultural resources in state.

Evidence at most archeological sites in Colorado are in relatively shallow deposits that are located either on the surface or within one to two feet of the surface. However, in some cases, natural factors have buried sites beneath multiple layers of sediment or organic materials, such as in floodplain deposits found along streams and rivers or peat deposits in wetlands. These deposits can range between one and ten feet below the current surface, with older sites in the deeper sediments. Disturbed ground, including urban areas, may contain archaeological resources in deeper or shallower strata than undisturbed areas (Harris, 1979).

The following sections provide additional detail about Colorado's prehistoric periods (approximately 14000 B.C. – A.D. 1600) and the historic period since European contact in the 1500s. Section 3.1.11.4 presents an overview of the initial human habitation in Colorado and the cultural development that occurred before European contact. Section 3.1.11.1 discusses the federally recognized American Indian tribes with a cultural affiliation to the state. Section 3.1.11.6 provides a current list of significant archaeological sites in Colorado and tools that the state has developed to ensure their preservation. Section 3.1.11.7 document the historic context of the state since European contact, and Section 3.1.11.8 summarizes the architectural context of the state during the historic period.

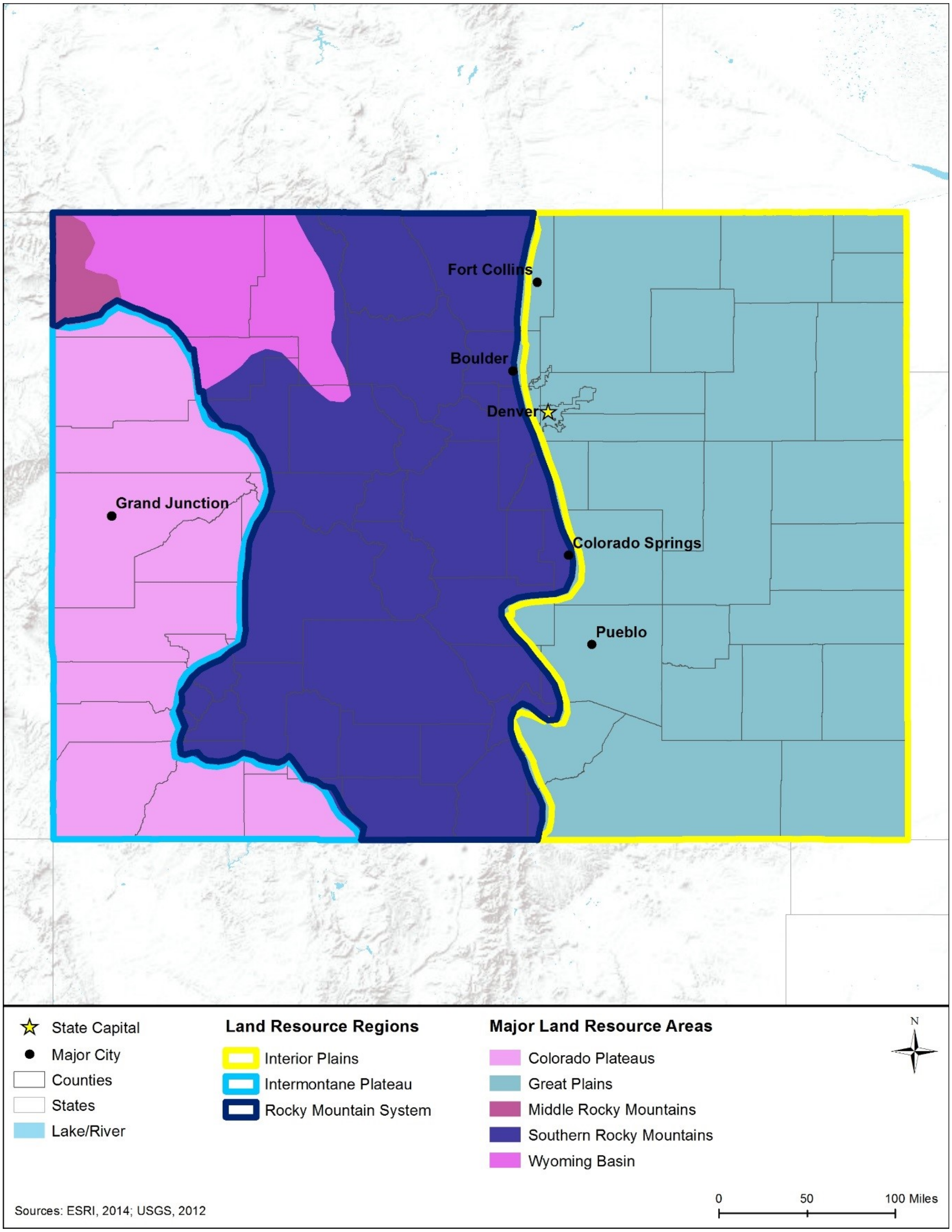

Figure 3.1.11-1: Colorado Physiographic Regions

3.1.11.4. Prehistoric Setting

Archaeologists divide Colorado's prehistoric past into three periods: The Paleoindian Period (14000 – 5500 B.C.), Archaic Period (5500 B.C. – A.D. 200), and Late Prehistoric Period (A.D. 200 – 1600) (USFWS, 2002d). Figure 3.1.11-2 shows a timeline representing these periods of early human habitation of present day Colorado. Evidence of early human occupation has been discovered in virtually every region of Colorado, including the Southwest, San Luis Valley, Rock Mountains, Great Basin, Northwest Plains, Northeastern Colorado, and the Western Plains (Keyser & Davis, 1982; Keyser & Knight, 1977; USFWS, 2002d; Cameron, 2005; Eighmy, 1984; Fumiyasu & Gerhardt, 2007). It is important to note that there is potential for undiscovered archaeological remains representing every prehistoric period throughout the state. Due to advancements in techniques and associating artifacts discovered with similar ones previously assigned to a particular range of the archaeological record, the periods associated with a particular time in North American human development continue to become increasingly accurate (Pauketat, 2012; Haynes, Donahue, Jull, & Zabel, 1984; Haynes, Johnson, & Stafford, 1999).

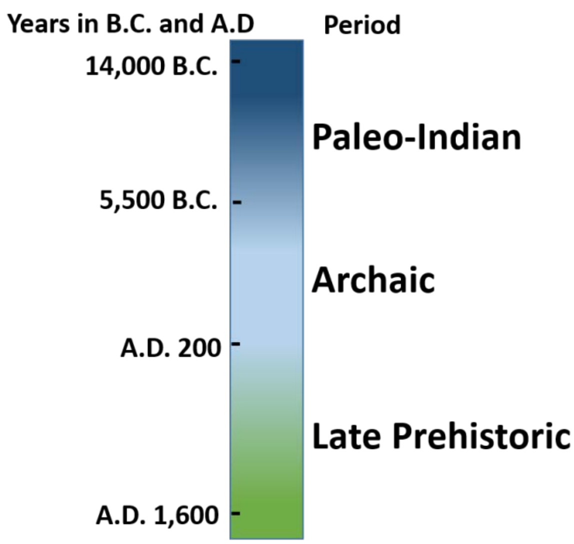

Figure 3.1.11-2: Timeline of Prehistoric Human Occupation

Source: (USFWS, 2002d)

Paleoindian Period (12,000 – 10,000 B.C.)

The Paleoindian Period represents the earliest human habitation Colorado. The earliest people to occupy the state were small groups of nomadic hunters and gatherers that used chipped-stone tools, including the "fluted javelin head" arrow and spear points, also referred to as the Clovis fluted point. Studies show that such technology was prevalent northeastern Asia, the Arabian Peninsula, and Spain prior to human arrival into North America (Charpentier & Inizan, 2002; NPS, 2015i). There are four stages of the Paleoindian period: Pre-Clovis period, Clovis period, Folsom period, and the Plano period. Each one of these stages are associated with particular tool assemblages called diagnostics and are helpful in determining the sequence of events in the archaeological record (Eighmy, 1984).

Most of the oldest known evidence of human settlement in Colorado can be attributed to the discovery of fluted points found in surface and shallow deposits throughout the state. Archaeologists hypothesize that the people of this period ranged across the state in small bands that followed migratory game such mammoth and giant bison. Early Paleoindian settlers used the Clovis fluted point technology to hunt this large game. These bands established seasonal camps, some of which likely became permanent settlements. They are probably related to the people who migrated to North America via a land bridge at the Bering Strait during the latter part of the last ice age (Late Pleistocene epoch) (Stiger, 2006; Eighmy, 1984).

Around ten to seven thousand years ago, there was gradual warming trend in this region, and the Folsom culture replaced the Clovis culture. The Folsom culture had more advanced methods for hunting bison, which lead to overhunting in the region. As hypothesized, the sophisticated hunting methods along with the climatological changes that were occurring at the time may have led to the distinction of the gradual extinction of the mammoth and other large animals. The Mountaineer site, near Gunnison, Colorado is an excellent example of the Folsom culture. Over 35,478 artifacts were collected from this site, including a structure of prehistoric origin. The majority of the material is from local sources. The Mountaineer site provides evidence that the people were processing large game such as bison, elk, deer, pronghorn and bighorn. (Stiger, 2006). The people were also exploiting small game and various types of edible wild plants they could identify (Eighmy, 1984).

Archaic Period (11000 B.C. – 3000 B.C.)

The climate had changed to a desert-like condition by around 5500 – 2000 B.C. Along with temperature increase, there was a shift in the economy of the culture. A diversification in the subsistence patterns of the people in response to this new dryer climate was beginning to take hold during this period. The people hunted larger game such as antelope, deer, and bison. Communal hunts was a common practice in where bands or groups of hunters would ambush large game or worked together to run herds of bison over a cliff to kill them (Guthrie, Gadd, Johnson, & Lischka, 1984).

During the Archaic Period, the people were exploiting small game as well, along with an increase in the processing of wild plant materials. Tools such as milling slabs, cobble handstones, end scrapers, choppers, scrapers, and cutting and drilling instruments provide evidence for understanding how the people were preparing food. They were processing and eating plants, foods such as, pinyon nuts, and wild grasses (Guthrie, Gadd, Johnson, & Lischka, 1984).

Throughout the Archaic Period, the period were primarily hunters and gathers who traveled in nomadic bands. They were very well adapted to the environment in which they lived (Guthrie, Gadd, Johnson, & Lischka, 1984; Kelly, 1997). Activity areas containing structures such as hearths, and living structures that appear to have doorways. One theory is that the people may have occupied structures and reused materials from the Paleoindian period. The processing of bison and other animals sometimes occurred at such older sites (Stiger, 2006; Eighmy, 1984).

Formative Period (A.D. 500 –1600)

The Formative period, also referred to as the Ceramic or Woodland period, was a time of increased advancements of technology. Many archaeological sites in Colorado represent this period of human development. As with much of North America during this period, the traditional hunter and gather way of life was ending and people were becoming more sedentary and establishing themselves in more permanent dwellings. During the Formative period, ceramics (pottery) became essential to the culture, which is evident in the archaeological record. It is important to note that hunting and gathering was still a way in which people were able to support themselves, however, by this period that had a more permanent place to return such as a village or hamlet (Eighmy, 1984).

The early part of the Formative period was a time where people were stating to settle into villages, while hunting and gathering was still a major part of their livelihood. Bands of people would disperse on hunting expeditions and return to dispersed villages. There were intermixed populations of hunter and gatherer societies with initial attempts of permanent settlement patterns. During the Formative period, people began to experiment with agriculture growing corn or maize, beans and other types of plants. Pottery decorating was becoming more elaborate during this time in human development (Eighmy, 1984).

Around A.D. 1000, the pottery became more elaborate. For example, in northeastern Colorado, globular vessels much like those that exist in Kansas and Nebraska are present. The vessels are attributed to a sedentary and horticultural lifestyle; however, in northern Colorado, hunting and gathering remained the predominant pattern of subsistence during this period (Eighmy, 1984).

In northern and southwest parts of Colorado (e.g., Chaco Canyon and Mesa Verde), social activity through the exchange of ideas and materials were taking place. This area consists of the Kayenta, Chaco, and Mesa Verde cultures. Although, these cultures were distinctly separate from one another, they shared technologies and ideas that lead to a flourishing human occupation in the region. Archaeologists hypothesized that the people who settled in this region came from multiple location in the state, and not one cohesive group. People were developing an elaborate social network. They built great houses, kivas and an intricate road network in northern area of the San Juan region of Colorado. The great houses were an extensive multiple storied pueblo style shelters that housed many families and extended families. (Cameron, 2005; Lekson, 1997).

3.1.11.5. Federally Recognized Tribes of Colorado

According to the Bureau of Indian Affairs and the National Conference of State Legislators, there are two federally recognized tribes in Colorado: the Southern Ute Indian Tribe of the Southern Ute Reservation, and the Ute Mountain Tribe of the Ute Mountain Reservation (Colorado, New Mexico and Utah) (National Conference of State Legislators, 2015; U.S. Government Publishing Office, 2015). The location of federally recognized tribes are shown in in Figure 3.1.11-3Figure 3.1.11-3. There are several other tribes depicted on the figure below that once lived in Colorado, but do not retain federal reservation or trust lands here any longer.

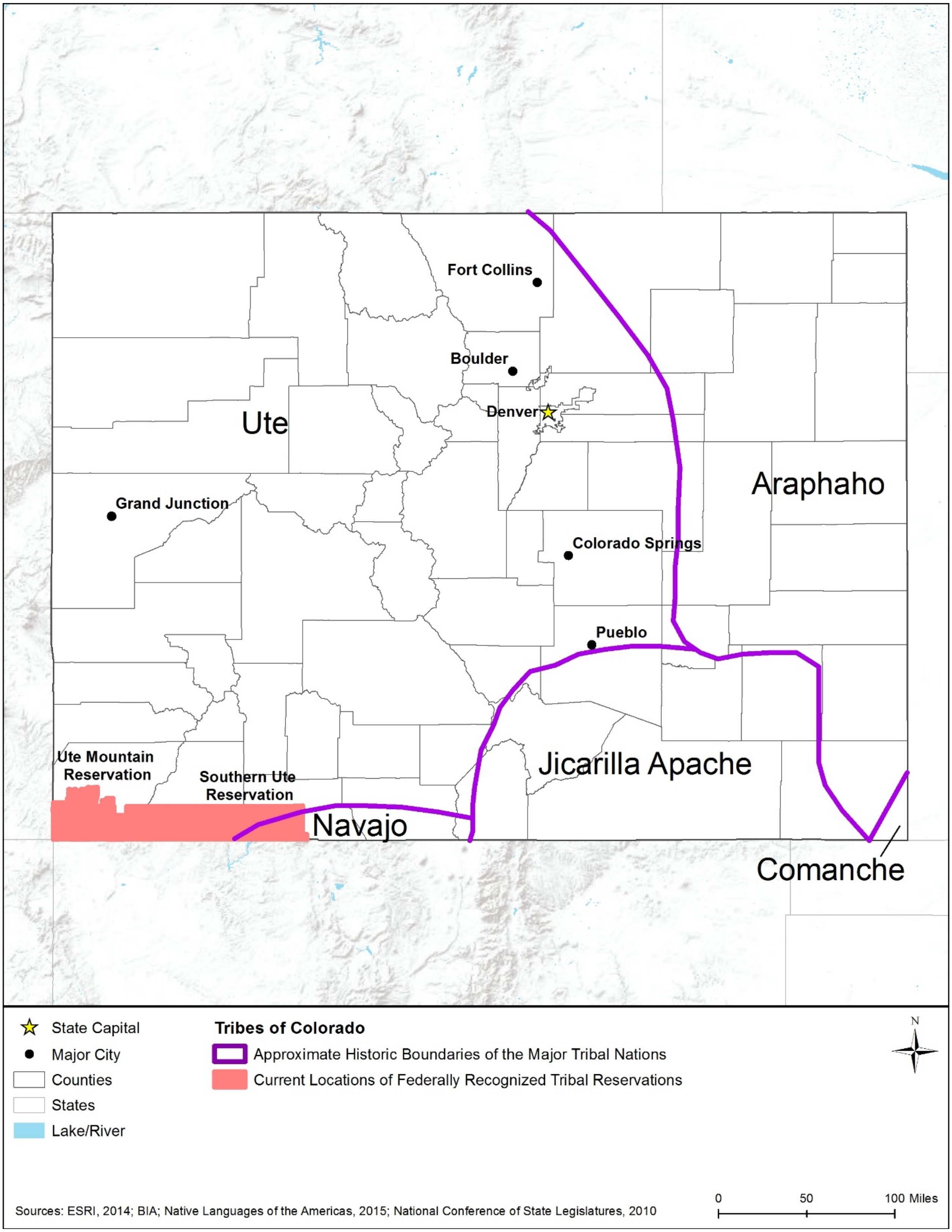

Figure 3.1.11-3: Approximate Historic Boundaries of Tribes in Colorado

3.1.11.6. Significant Archaeological Sites of Colorado

As previously mentioned in Section 11.14.3 there are 89 archaeological sites in Colorado listed on the NRHP. Table 3.1.11-2 lists the names of the sites, the city they are closest to, and type of site. The list includes both prehistoric and historic archaeological sites. The number of archaeological sites may increase with the discovery of new sites. A current list of NRHP sites are listed on the NRHP website at (http://www.nps.gov/nr/) (NPS, 2014g).

Colorado State Cultural Resources Database and Tools

Office of Archaeology and Historic Preservation (OAHP)

The Office of Archaeology and Historic Preservation maintains a multitude of resources on their website (http://www.historycolorado.org/archaeologists/office-archaeology-historic-preservation) for users interested in Colorado history including preservation news, helpful links, job listings, and online exhibits. *Compass* is the state's online cultural resource database, and is maintained by the OAHP. Access is granted to qualified individuals who apply through the website. The OAHP site also provides wide selection of publications that may be downloaded at no cost. (OAHP, 2016)

History Colorado Online Collection

The History Colorado Online Collection is a publicly accessible archive of Colorado artifacts and photographs. The collection is maintained by the Stephen H. Hart Library and Research Center. The center is open throughout the week for those who wish to view the artifacts in person. If requested, center staff will also provide assistance with research and can create photo reproductions.

Colorado Archaeological Society (CAS)

The Colorado Archaeological Society (CAS) is an organization for people interested in Colorado history and prehistory. The group's website hosts numerous resources such as information on purchasing a variety of publications, access to the CAS quarterly newsletter, contact lists, and a bulletin board for announcements. The group also sponsors multiple scholarships for students studying archaeology; information and applications are located on their site. (CDOT, 2015e)

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

Closest City	Site Name	Type of Site
Austin	Ferganchick Orchard Rock Art Site	Historic - Aboriginal, Prehistoric
Basalt	Archeological Site 5EA484	Prehistoric
Bayfield	Spring Creek Archeological District	Historic - Aboriginal, Prehistoric
Boulder	Boulder County Poor Farm	Historic
Cahone	Ansel Hall Ruin	Historic - Aboriginal, Prehistoric
Calhan	Calhan Paint Mines Archeological District	Historic, Prehistoric
Chimney Rock	Chimney Rock Archeological Site	Prehistoric

Closest City	Site Name	Type of Site
Como	Boreas Railroad Station Site	Historic
Cortez	Cannonball Ruins	Prehistoric
Cortez	Indian Camp Ranch Archeological District	Historic - Aboriginal, Prehistoric
Cortez	Mitchell Springs Archeological Site	Prehistoric
Cortez	Mud Springs Pueblo	Prehistoric
Cortez	Roy's Ruin	Prehistoric
Cortez	Sand Canyon Archaeological District	Prehistoric
Cortez	Wallace Ruin	Prehistoric
Dillon	Porcupine Peak Site	Prehistoric
Dinosaur	Castle Park Archeological District	Historic - Aboriginal, Prehistoric
Dinosaur	Mantle's Cave	Prehistoric
Dolores	Beaver Creek Massacre Site	Historic - Aboriginal, Military
Dolores	Anasazi Archeological District	Prehistoric
Dolores	Escalante Ruin	Historic, Prehistoric
Durango	Durango Rock Shelters Archeology Site	Prehistoric
Durango	Ute Mountain Ute Mancos Canyon Historic District	Prehistoric
Eads	Sand Creek Massacre Site	Historic - Aboriginal, Military
Estes Park	Homestead Meadows Discontiguous District	Historic
Farisita	Montoya Ranch	Historic
Fort Collins	Lindenmeier Site	Prehistoric
Fort Garland	Fort Garland	Military
Franktown	Evans Homestead Rural Historic Landscape	Historic
Franktown	Franktown Cave	Historic, Prehistoric
Golden	Magic Mountain Site	Prehistoric
Grand Lake	Lulu City Site	Historic
Gunnison	Chance Gulch Site	Prehistoric
Gunnison	Curecanti Archeological District	Prehistoric
Hartsel	Threemile Gulch	Prehistoric
Hooper	Trujillo Homesteads	Historic
Keota	Keota Stone Circles Archeological District	Prehistoric
Kersey	Jurgens Site	Prehistoric
Kremmling	Barger Gulch Locality B	Prehistoric
La Garita	Carnero Creek Pictographs	Prehistoric
La Junta	Bent's Old Fort National Historic Site	Military

Closest City	Site Name	Type of Site
Lake City	Argentum Mining Camp	Historic
Lake City	Little Rome	Historic
Lake City	Tellurium--White Cross Mining Camp	Historic
Lakewood	South Ranch	Prehistoric
Las Animas	Fort Lyon	Historic, Military, Historic-Aboriginal
Leadville	Camp Hale Site	Military
Littleton	Lamb Spring	Prehistoric
Ludlow	Ludlow Tent Colony Site	Historic
Mancos	Lost Canyon Archeological District	Prehistoric
Meeker	Battle of Milk River Site	Historic - Aboriginal, Military
Meeker	Duck Creek Wickiup Village	Historic - Aboriginal
Montrose	Shavano Valley Rock Art Site	Prehistoric
Montrose	Shavano Valley Rock Art Site (Boundary Increase)	Prehistoric
Montrose	Ute Memorial Site	Historic - Aboriginal
Morrison	Bradford House III Archeological Site	Prehistoric
Morrison	LoDaisKa Site	Prehistoric
Mosca	Indian Grove	Historic - Aboriginal
Nederland	Cardinal Mill	Historic
Penrose	Indian Petroglyphs and Pictographs	Prehistoric
Platteville	Fort Vasquez	Historic
Pleasant View	Lancaster, James A., Site	Prehistoric
Pleasant View	Painted Hand Pueblo	Prehistoric
Pleasant View	Pigge Site	Prehistoric
Pueblo	El Pueblo	Historic, Historic - Aboriginal
Radium	Yarmony Archeological Site	Prehistoric
Rangely	Canon Pintado	Historic - Aboriginal, Prehistoric
Rangely	Carrot Men Pictograph Site	Prehistoric
Rangely	Collage Shelter Site	Prehistoric
Rangely	Fremont Lookout Fortification Site	Prehistoric
Ruxton	Colorado Millennial Site	Historic, Military, Historic-Aboriginal, Prehistoric
Silverton	Animas Forks	Historic
Silverton	Minnie Gulch Cabins	Historic
Sparks	White-Indian Contact Site	Historic, Historic - Aboriginal

Closest City	Site Name	Type of Site
Stoneham	West Stoneham Archeological District	Historic - Aboriginal, Prehistoric
Telluride	Fort Peabody	Military
Trinchera	Trinchera Cave Archeological District	Historic - Aboriginal, Prehistoric
Vicksburg	Crescent Moly Mine No. 100 and Mining Camp	Historic
Villegreen	Torres Cave Archeological Site	Prehistoric
Waterton	Roxborough State Park Archaeological District	Historic, Prehistoric
Whitewater	Bloomfield Site	Prehistoric
Windsor	Kaplan--Hoover Site	Prehistoric
Yellow Jacket	Albert Porter Pueblo	Prehistoric
Yellow Jacket	Archeological Site no. 5MT4700	Prehistoric
Yellow Jacket	Bass Site	Prehistoric
Yellow Jacket	Joe Ben Wheat Site Complex	Prehistoric
Yellow Jacket	Seven Towers Pueblo	Prehistoric
Yellow Jacket	Woods Canyon Pueblo	Prehistoric
Yellow Jacket	Yellowjacket Pueblo (5-MT-5)	Prehistoric

Source: (NPS, 2014g)

3.1.11.7. Historic Context

The first Europeans in present-day Colorado were the Spanish conquistadors, possibly as early as the late 16th century. Spain explored parts of the territory during the 16th and 17th centuries in search of gold, but did not establish a lasting settlement. In 1803, the United States gained a portion of Colorado as a part of the Louisiana Purchase; however, Louis and Clark did not venture into Colorado while on their exploratory mission. In 1806, United States military officer named Zebulon Pike led an expedition into Colorado in order to explore the Rio Grande and Arkansas River. Fur trappers and explorers followed over the next few decades, establishing trading posts and small settlements (Abbott, Leonard, & McComb, 1994).

In 1848, following the Mexican-American War, the Treaty of Guadalupe Hidalgo transferred control of much of the remaining southwest to the United States, including all of Colorado. In 1858, gold was discovered near present-day Denver; by 1859, the “Pikes Peak Gold Rush” was attracting prospectors, and in 1861, Colorado became a territory. During the Civil War, Coloradans fought on the side of the Union, most notably at the Battle of Glorietta Pass in New Mexico. While no Civil War battles occurred in Colorado, a bloody Indian conflict with the Cheyenne and Arapaho Indians took place at the same time. Denver became the capital in 1867, and on August 1, 1876, Colorado became the 38th state (Abbott, Leonard, & McComb, 1994).

Silver was discovered in the 1870s, leading to major conflicts with the Ute Indians who controlled the land in western Colorado where much of the silver was located. After the Utes were forcibly relocated to Utah, the land in western Colorado became available for non-indigenous settlement. Transportation improvements such as train travel facilitated development during the latter part of the 19th century, and many Americans with health issues relocated to Colorado because the dryer climate was thought to improve conditions like tuberculosis (Abbott, Leonard, & McComb, 1994).

Mining continued to be important into the 20th century, with several mining strikes occurring during the late 19th and early 20th centuries. Violence relating to strikes was common, with the Ludlow Massacre in 1914 being particularly bloody.[129] During World War I (WWI), Coloradans volunteered in larger numbers for the military, as they did again during World War II (WWII). Troops were also trained for winter conditions in Colorado as ski troops. Following WWII, Colorado was chosen to host the North American Air Defense Command (NORAD), as well as the United States Air Force Academy (Abbott, Leonard, & McComb, 1994).

Beginning in the late 19th century, but especially moving into the 20th century, Colorado began to promote itself as a tourist destination, and today the state benefits from tourists attracted to a wide variety of natural and cultural resources. Recreational tourism is important as well, particularly relating to skiing. Infrastructure has in turn arisen related to this industry, including early-to-mid 20th century ski lodges that are now historic (Abbott, Leonard, & McComb, 1994).

Colorado has 1,480 NRHP listed sites, as well as 25 National Historic Landmarks (NHL) (NPS, 2015l). Colorado contains three National Heritage Area (NHA), the Cache La Poudre River Corridor National Heritage Area, the South Park National Heritage Area, and the Sangre de Cristo National Heritage Area (NPS, 2015m).

Figure 3.1.11-4 shows the location NHA and NRHP sites within the state of Colorado.[130]

[129] The Colorado National Guard, with the assistance of the mining company security forces, killed over twenty striking miners and their families.
[130] See Section 3.1.7 for a more in-depth discussion of additional historic resources as they relate to recreational resources.

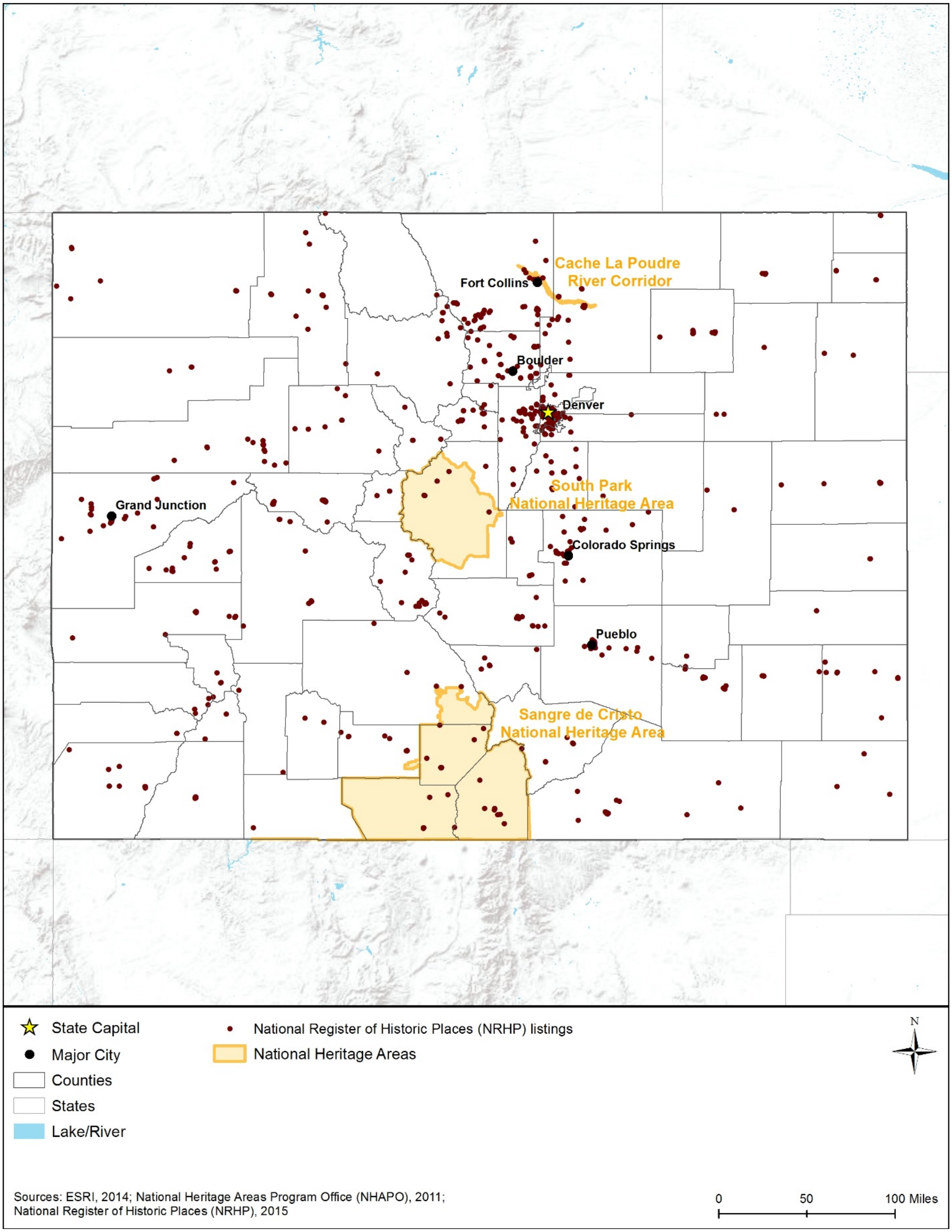

Figure 3.1.11-4: National Heritage Area (NHA) and National Register of Historic Places (NRHP) Sites in Colorado

3.1.11.8. Architectural Context

Examples of indigenous architecture in Colorado still exist, such as the Mesa Verde cliff dwellings which were constructed of local sandstone with adobe mortar. Cliff Palace is the largest of these ruins and is thought to be over 1,000 years old. The earliest European architecture in Colorado appeared in the form of small Spanish settlements in the southern portion of the state. "Small adobe plaza towns were established, first along the Culebra River, where San Luis (1851) claims to be the state's oldest permanent town" (Noel, 1997).

Following the Mexican-American War, American settlers began to move west into present-day Colorado, and traditional forms of indigenous and Spanish architecture was shunned.[131] In some cases adobe bricks were painted to look like red clay bricks. One example of where adobe was used despite its general disfavor is Bent's Old Fort, a trading post in the southeastern corner of the state that dates to the 1830s. Bent's Old Fort is now a National Historic Site and was reconstructed by the National Park Service in 1976. Revival architecture replicating this early style became popular in the 20th century, and residential, commercial, and institutional examples exist. The National Center for Atmospheric Research in Boulder, a Modernist building designed by I.M. Pei is a notable example (Noel, 1997).

As Pike's Peak Gold Rush (1858-1861) drew thousands of settlers westward, mining towns were hastily constructed. Towns arose without any planning, and dwellings were commonly constructed of Cottonwood timbers with mud and sod roofs. These structures have not survived well into the present. Saloons were common and served a variety of public and social functions. These buildings were often constructed with false-fronts, and were sometimes either rebuilt or upgraded depending on the success of the settlement.[132] Stage coach stops were common as well, some of which still exist today. As was the case with other western states involved in mining, if the mine succeeded, log structures were replaced with brick or stone, particularly commercial and institutional buildings. Contrarily, if the mine failed, the settlement was abandoned completely. As a result, ghost towns are common throughout the state and serve as popular tourist attractions (Noel, 1997).

Transportation resources were significant to the development of Colorado. Due to the elevation changes throughout the state, narrow gauge rail lines were used in order to successfully make turns and climb mountains. Rail travel became available in the 1870s, bringing with it an increase in population, and greater access to materials and popular architectural styles. Wealthy Coloradans constructed homes in Victorian Era styles, with masonry and cast iron becoming popular building materials. Post Offices, churches, and especially schools were seen as critical signs of modern civilization manifesting itself in the west, and many of these still exist today (Noel, 1997). Schools ranged in size from one room structures to large multistory buildings in larger settlements, and continued to be the focus of public works projects up through the New Deal programs of the Great Depression. As with other buildings, schools built during the Great Depression Exhibit Depression Era styles and motifs such as Art Deco and Art Moderne (Pearce

[131] Laws were passed in some areas discouraging the use of adobe brick construction in favor of kiln fired clay bricks.
[132] False-front buildings were quickly constructed, often of poor materials, but featured large, flat façades that allowed for ample signage and presented the appearance of an urban structure.

& Wilson, 2008). Churches often exhibited the styles common to the ethnic heritage of the builders, while late 19th-century hotels reflect many of the modern amenities of the Gilded Age (Noel, 1997).

Many late 19th and early 20th century towns were established in relation to the railroads. As the 20th century arrived, automobile oriented development began to dominate, often resulting in damage to historic downtowns. In addition, sprawling suburban development is common, both residential and commercial, with historic suburban shopping centers now experiencing similar decay to urban centers. This trend has continued to worsen following WWII. Airports have now become centers of activity, similar to the railroads of the past, and many display impressive architectural designs. Denver International Airport is a notable example of late 20th-century modernist architecture (Noel, 1997).

Architecture related to tourism is popular in Colorado, particularly Alpine style ski resorts beginning in the early 20th century. These often include steep roofs and decorative half-timbering, replicating styles found in Switzerland (Noel, 1997). The United States military has a presence in Colorado, and associated buildings include utilitarian architecture typical of military installations. The United States Air Force Academy campus in Colorado Springs includes a collection of Modernist structures designed by the renowned architectural firm of Skidmore, Owings, and Merrill, with the chapel being an architecturally distinctive building designed in 1962 by Walter Netsch of that firm.

Figure 3.1.11-5: Representative Architectural Styles of Colorado

Top Left – Air Force Academy Chapel (Colorado Springs, CO) – (Highsmith, 2007)
Top Right – Fitzsimons General Hospital, Open Air Tuberculosis Ward (Aurora, CO) – (Historic American Buildings Survey, 1933)
Bottom Left – Ghost Mining Town (Ashcroft, CO) – (Wolcott, 1941)
Bottom Right – Cliff Palace (Mesa Verde, CO) – (Photochrom Company, 1898)

3.1.12. Air Quality

3.1.12.1. Definition of the Resource

Air quality in a geographic area is determined by the type and amount of pollutants emitted into the atmosphere, the size, and topography[133] 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)[134] or micrograms per cubic meter (µg/m3) determined over various periods of time (averaging time).[135] This section discusses the existing air quality in Colorado. USEPA designates areas within the United States as attainment,[136] nonattainment,[137] maintenance,[138] or unclassifiable[139] 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.

3.1.12.2. Specific Regulatory Considerations

National and State Ambient Air Quality Standards

The Clean Air Act (CAA) establishes National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: Carbon monoxide (CO), lead, oxides of nitrogen (NO_X), particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), and oxides of sulfur (SO_X). The NAAQS establish various standards, either primary[140] or secondary,[141] for each pollutant with varying averaging times. Standards with short averaging times (e.g., 1-hour, 8-hour, and 24-hour) were developed to prevent the acute health effects from short-term exposure at high concentrations. Longer averaging periods (e.g., 3 months or annual) are intended to prevent chronic health effects from long-term exposure. 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, 2016e). 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

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[133] Topography: The unique features and shapes of the land (e.g., valleys and mountains).
[134] Equivalent to 1 milligram per liter (mg/L).
[135] 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, 2015c).
[136] Attainment areas: Any area that meets the national primary or secondary ambient air quality standard for the pollutant (USEPA, 2015a).
[137] 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, 2015a).
[138] 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, 2015a).
[139] 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, 2015a).
[140] 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, 2014d).
[141] 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, 2014d).

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, Colorado maintains its own air quality standards for Sulfur Dioxide (SO_2), the Colorado Ambient Air Quality Standards (CAAQS). Table 3.1.12-1 presents an overview of the CAAQS as defined by Colorado Department of Public Health and Environment (CDPHE), Air Pollution Control Division (APCD).

Table 3.1.12-1: Colorado Ambient Air Quality Standards (CAAQS)

Pollutant	Averaging Time	Primary Standard		Secondary Standard		Notes
		$\mu g/m^3$	ppm	$\mu g/m^3$	ppm	
SO_2	3-hour	700	0.267	-	-	Not to be exceeded more than once per 12-month period.

Source: (CDPHE, 2010)

Title V Operating Permits/State Operating Permits

Colorado 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, 2016c). The overall goal of the Title V program is to “reduce violations of air pollution laws and improve enforcement of those laws” (USEPA, 2016c). Colorado Regulation Number 3, Part C describes the applicability of Title V operating permits. Colorado requires Title V operating permits for any major source if it emits or has the potential to emit pollutants in excess of the major source thresholds (see Table 3.1.12-2). The permit issued to a facility contains both state and federal portions and incorporates a reporting schedule (USEPA, 2014a).

Table 3.1.12-2: Major Air Pollutant Source Thresholds

Any Pollutant	100 Tons per Year
Single Hazardous Air Pollutant (HAP)	10 Tons per Year
Total/Cumulative HAPs	25 Tons per Year

Source: (USEPA, 2014b)

The CDPHE has various permits and requirements for owners and operators of emission equipment and activities - an Air Pollutant Emission Notice (APEN), Construction Permits, and Operating Permits. The lowest level of reporting is the APEN, which is covered under Colorado Regulation 3 Part A, II.B.3 (APEN Applicability). The APEN is a form an owner/operator uses to report emission calculations to the state, which the state regulators then use to determine the need for Construction and Operating Permits (CDPHE, 2015t). State Construction Permits are covered under Part B of Regulation 3 and are required for all sources that commenced construction on or after February 1, 1972, unless they meet specific exemptions. Finally, Operating Permits are covered under Part C of Regulation 3 and are required for sources of air pollutants, unless those sources meet specific exemptions (CDPHE, 2015s).

Air Pollutant Emission Notice (APEN)

The APEN is an emissions calculation notice that is required to be completed for any "emission of air pollutants from, or construction, modification or alteration of, any facility, process, or activity which constitutes a stationary source, except residential structures, from which air pollutants are, or are to be, emitted" (including but not limited to internal combustion engines, non-road engines, and emergency power generators), unless they meet specific exemptions (CDPHE, 1997). An APEN is also used to obtain an air permit, if one is required by the emissions source or construction activity. Regulation 3 Part A, Section II.D (Exemptions from APEN Requirements) lists the following sources as "exempt from the requirement to file APEN's because by themselves, or cumulatively as a category, they are deemed to have a negligible impact on air quality.

- "Individual emission points in nonattainment areas having uncontrolled actual emissions of any criteria pollutant of less than one ton per year, and individual emission points in attainment or attainment/maintenance areas having uncontrolled actual emissions of any criteria pollutant of less than two tons per year, and each individual emission point with uncontrolled actual emissions of lead less than one hundred pounds per year, regardless of where the source is located.
- Individual emission points having uncontrolled actual emissions of any individual non-criteria reportable pollutant less than 250 pounds per year.
- Emissions from, or construction, or alteration of residential structures, including all buildings or other structures used primarily as a place of residence, and including home heating devices.
- Disturbance of surface areas for purposes of land development, that do not exceed twenty-five contiguous acres and that do not exceed six months in duration. (This does not include mining operations or disturbance of contaminated soil).
- Internal combustion engines powering portable drilling rigs.
- Non-road engines as defined in Section I.B.31. of this Part A [Non-Road Engine], except certain non-road engines subject to state-only air pollutant emission notice and permitting requirements pursuant to Section I.B.31.c. [(State-only Requirements) Non-road engines not co-located at an existing major source] and I.B.31.d. [(State-only Requirements) Non-road engines co-located at an existing major source of nitrogen oxides or sulfur dioxide] of this part…" (CDPHE, 2016a).

"Stationary sources having emission units that are exempt from the requirement to file an Air Pollutant Emission Notice [APEN] must nevertheless comply with all requirements that are otherwise applicable specifically to the exempted emission units, including, but not limited to: Title V, Prevention of Significant Deterioration, nonattainment New Source Review, opacity limitations, odor limitations, particulate matter limitations and volatile organic compounds controls…" (CDPHE, 2016a).

Exempt Activities

CDPHE exempts the following sources from obtaining an operating permit under Regulation 3, Part C II.E. (Insignificant Activities and Exemptions from Operating Permit Requirements):

- "…Certain categories of sources and activities which are considered to be insignificant contributors to air pollution as listed below. A source solely comprised of one or more of these activities are not required to obtain an operating permit pursuant to this regulation, unless the source's emissions trigger the major source threshold as defined in Section I.B.25. of Part A of this Regulation Number 3 (definition of major source):
- Individual emission points in nonattainment areas having uncontrolled actual emissions of any criteria pollutant (as defined in Section I.B.17. [Criteria Pollutants] of Part A of this Regulation Number 3) of less than one ton per year, and individual emission points in attainment or attainment/maintenance areas having uncontrolled actual emissions of any criteria pollutant of less than two tons per year, and each individual emission point with uncontrolled actual emissions of lead less than one hundred pounds per year, regardless of where the source is located.
- Individual emission points of non-criteria reportable pollutants having uncontrolled actual emissions less than the de minimis[142] levels as determined following the procedures set forth in Appendix E [De Minimis Level For Non-Criteria Reportable Pollutants]…
- Disturbance of surface areas for purposes of land development, that do not exceed twenty-five contiguous acres and that do not exceed six months in duration. (This does not include mining operations or disturbance of contaminated soil)…
- Internal combustion engines powering portable drilling rigs...
- Storage of butane, propane, or liquefied petroleum gas in a vessel with a capacity of less than sixty thousand gallons….
- Storage tanks of capacity less than forty thousand gallons of lubricating oils or waste lubricating oils…
- Stationary Internal Combustion Engines that:
    - Are power portable drilling rigs; or
    - Are emergency power generators that operate no more than two hundred fifty hours per year; or
    - Have uncontrolled actual emissions less than five tons per year or manufacturer's site-rated horsepower of less than fifty…
- Stationary internal combustion engines:
    - Less than or equal to 175 horsepower which operate less than 1,450 hours per year.
    - Greater than 175 horsepower and less than or equal to 300 horsepower which operate less than 850 hours per year.
    - Greater than 300 horsepower and less than or equal to 750 horsepower which operate less than 340 hours per year…" (CDPHE, 2016a).

[142] de minimis: USEPA states that "40 CFR 93 § 153 defines de minimis levels, that is, the minimum threshold for which a conformity determination must be performed, for various criteria pollutants in various areas." (USEPA, 2016f)

Temporary Emissions Sources Permits

Colorado does not have regulations for temporary emission source permitting. Any temporary emission sources should review applicable construction and stationary source requirements, or contact the CDPHE for additional assistance.

State Preconstruction Permits

Regulation 3, Part B II.D details the exemptions from Construction Permits (also known as Air Permits). Permit exemptions do not change the applicability of any federal or state requirements and regulations.

"The following sources are exempt because by themselves, or cumulatively as a category, they are deemed to have a negligible impact on air quality:

- Those sources exempted from the filing of Air Pollutant Emission Notices [APEN] in Section II.D. of Part A [Exemptions from APEN Requirements], of this regulation…
- Stationary Internal Combustion Engines that:
    - Are power portable drilling rigs; or
    - Are emergency power generators that operate no more than two hundred and fifty hours per year; or
    - Have uncontrolled actual emissions less than five tons per year or manufacturer's site-rated horsepower of less than fifty…
- Each individual piece of fuel burning equipment, other than smokehouse generators, that uses gaseous fuel, and that has a design rate less than or equal to ten million British Thermal Units[143] per hour…" (CDPHE, 2016a).

"Facilities located in a nonattainment area for any criteria pollutant for which the area is nonattainment; with total facility uncontrolled actual emissions (potential emissions at actual operating hours) that are less than the following amounts" (Table 3.1.12-3). (CDPHE, 2016a)

[143] One British Thermal Unit is the amount of heat needed to raise the temperature of one pound of water by 1 °F. (EIA, 2015g)

Table 3.1.12-3: Permit Thresholds - Nonattainment

Pollutant	Uncontrolled Actual Emissions
Volatile Organic Compounds	2 Tons Per Year
PM_{10}	1 Tons Per Year
$PM_{2.5}$	1 Tons Per Year
Total Suspended Particulate	5 Tons Per Year
Carbon Monoxide	5 Tons Per Year
Sulfur Dioside	5 Tons Per Year
Nitrogen Oxides	5 Tons Per Year
Lead	200 Pounds Per Year

Source: (CDPHE, 2016a)

"Facilities located in attainment or attainment/maintenance areas for all criteria pollutants with total facility uncontrolled actual emissions less (potential emissions at actual operating hours) than the following amounts" (Table 3.1.12-4). (CDPHE, 2016a)

Table 3.1.12-4: Permit Thresholds - Attainment

Pollutant	Uncontrolled Actual Emissions
Volatile Organic Compounds	5 Tons Per Year
PM_{10}	5 Tons Per Year
$PM_{2.5}$	5 Tons Per Year
Total Suspended Particulate	10 Tons Per Year
Carbon Monoxide	10 Tons Per Year
Sulfur Dioside	10 Tons Per Year
Nitrogen Oxides	10 Tons Per Year
Lead	200 Pounds Per Year

Source: (CDPHE, 2016a)

General Conformity

Established under Section 176(c)(4) of the CAA, "the General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality" outlined in the state implementation plan (SIP) (USEPA, 2013a). An action in designated nonattainment and maintenance areas would be evaluated for the emission of those particular pollutants under the General Conformity Rule through an applicability analysis. Pursuant to Title 40 CFR 93.153(d)(2) and (e), federal actions "in response to emergencies which are typically commenced on the order of hours or days after the emergency" and actions "which are part of part of a continuing response to emergency or disaster" that are taken up to 6 months after beginning response activities, will be exempt from any conformity determinations (U.S. Government Publishing Office, 2010).

The estimated pollutant emissions are compared to *de minimis* levels. These values are the minimum thresholds for which a conformity determination must be performed (see Table 3.1.12-5). No Colorado counties lie in the Ozone Transport Region (OTR).

Table 3.1.12-5: *De Minimis* Levels

Pollutant	Area Type	Tons Per Year
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
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. Government Publishing Office, 2010)

If an action does not result in an emissions increase above the *de minimis* levels in Table 3.1.12-5 then a conformity determination is not required. If the applicability analysis shows that the total direct and indirect emissions are above the *de minimis* levels in Table 3.1.12-5, then the action must undergo a conformity determination. The federal agency must first show that the action would meet all SIP control requirements and that any new emissions would not cause a new violation of the NAAQS. To demonstrate conformity,[144] the agency would have to fulfill one or more of the following:

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

State Implementation Plan Requirements

The Colorado SIP is composed of many related actions to ensure ambient air concentrations of the six criteria pollutants comply with the NAAQS. Colorado's SIP is a conglomeration of separate actions taken for each of the pollutants. All of Colorado's SIP actions are codified under 40 CFR Part 52 Subpart G. A list of all SIP actions for all six criteria pollutants can be found on CDPHE's https://www.colorado.gov/pacific/cdphe/state-implementation-plans-sips

3.1.12.3. Environmental Setting: Ambient Air Quality

Nonattainment Areas

The USEPA classifies areas as attainment, nonattainment, maintenance, or unclassifiable for six criteria pollutants. When evaluating an area's air quality against regulatory thresholds (i.e., permitting and general conformity), maintenance areas are often combined with nonattainment, while unclassifiable areas are combined with attainment areas. Figure 3.1.12-1 and Table 3.1.12-6 present the nonattainment areas in Colorado as of January 30, 2015. The year(s) listed in the table for each pollutant indicate when USEPA promulgated the standard for that pollutant; note that, for PM_{10}, O_3, and CO, these standards listed are in effect. Unlike Table 3.1.12-6, Figure 3.1.12-1 does not differentiate between standards for the same pollutant. Additionally, given that particulate matter is the criteria pollutant of concern, PM_{10} and $PM_{2.5}$ merge in the figure to count as a single pollutant.

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

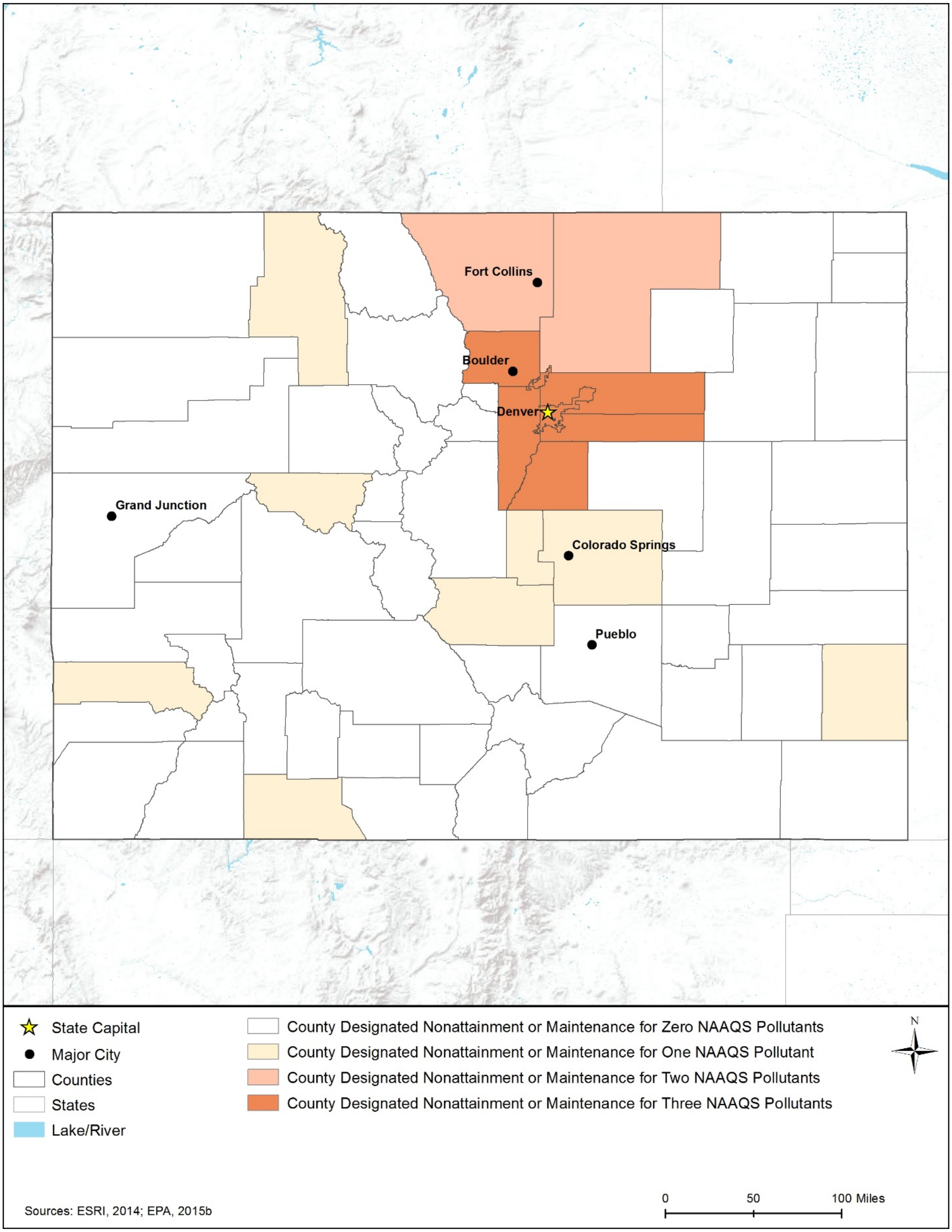

Figure 3.1.12-1: Nonattainment and Maintenance Counties in Colorado

Table 3.1.12-6: Colorado Nonattainment and Maintenance Areas by Pollutant Standard and County

County	Pollutant[a] and Year USEPA Implemented Standard										
	CO	Lead		NO_2	PM_{10}	$PM_{2.5}$		O_3		SO_2	
	1971	1978	2008	1971	1987	1997	2006	1997	2008	1971	2010
Adams	M				M			X-5	X-5		
Arapahoe	M				M			X-5	X-5		
Archuleta					M						
Boulder	M				M			X-5	X-5		
Broomfield	M				M			X-5	X-5		
Denver	M				M			X-5	X-5		
Douglas	M				M			X-5	X-5		
El Paso	M										
Fremont					M						
Jefferson	M				M			X-5	X-5		
Larimer	M							X-5	X-5		
Pitkin					M						
Prowers					M						
Routt					M						
San Miguel					M						
Teller	M										
Weld	M							X-5	X-5		

Source: (USPEA, 2015b)

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

[a] The years under each pollutant represent the year that the specific national standard was implemented.

Air Quality Monitoring and Reporting

The CDPHE, APCD measures air pollutants at 59 sites across the eight air quality regions throughout the state as part of the National Air Monitoring Stations Network and the State and Local Air Monitoring Stations Network (Colorado DPHE, 2015). Annual Colorado State Ambient Air Quality Reports are prepared, containing pollutant data summarized by region. The CDHEP APCD reports real-time pollution levels of particulate and ozone on their website (http://www.colorado.gov/airquality/air_quality.aspx) to inform the public, as particulate and ozone are the main pollutants of concern in Colorado.

Throughout 2013, O_3 measurements exceeded the federal standard of 0.075 ppm 74 times in stations across the state. Also in 2013, PM_{10} measurements exceeded the federal standard of 150 μg/m3 20 times in stations across the state. Additionally, in 2013, $PM_{2.5}$ measurements exceeded the federal standard for 24-hour of 35 ppm four times at Grand Junction Powell Building. Finally, in 2013, SO_2 measurements exceeded the federal standard of 0.075 ppm twice at Colorado Springs (HWY 24). Table 3.1.12-7 details the locations, exceedances, and frequency of all exceedances in 2013. No other criteria pollutants exceed federal standards. (Colorado DPHE, 2015)

Table 3.1.12-7: Colorado Exceedances for National Ambient Air Quality Standards (NAAQS) in 2013

Monitoring Location	Number of O_3 Exceedance	Number of PM_{10} Exceedance	Number of $PM_{2.5}$ Exceedance	Number of SO_2 Exceedance
NREL	11	0	0	0
Rocky Flats N	10	0	0	0
Chatfield State Park	9	0	0	0
BLM Rangely Golf Course	9	0	0	0
Fort Collins West	5	0	0	0
Welby	4	0	0	0
Highlands Reservoir	4	0	0	0
South Boulder Creek	4	0	0	0
Welch	3	0	0	0
Aspen Park	3	0	0	0
Aurora East	2	0	0	0
LaCasa	2	0	0	0
Manitou Springs	2	0	0	0
Rocky Mountain NP	2	0	0	0
Mt. Crested Butte Realty	1	1	0	0
USFS Shamrock	1	0	0	0
Fort Collins CSU	1	0	0	0
Greely – Weld Cntry. Tower	1	0	0	0
Lamar Municipal	0	7	0	0
Alamosa Adams State College	0	4	0	0
Almosa Municipal Building	0	3	0	0
Pagosa Springs	0	3	0	0
Durango	0	1	0	0
Telluride	0	1	0	0
Grand Junction Powell Building	0	0	4	0
Colorado Springs (HWY 24)	0	0	0	2
TOTAL:	**74**	**20**	**4**	**2**

Source: (Colorado DPHE, 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 kilometers[145] 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 50 kilometers[146] (the normal useful range of EPA-approved Gaussian plume models)" (USEPA, 1992).

Colorado contains 12 Federal Class I areas; all 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, 1992). Utah does have two Class I areas and New Mexico has one Class I area where the 100-kilometer buffer intersects a few Colorado counties. Any PSD-applicable action within these counties would require FLMs notification from the appropriate Regional Office. Figure 3.1.12-2 provides a map of Colorado highlighting all relevant Class I areas and all areas within the 100-kilometer radiuses. The numbers next to each of the highlighted Class I areas in Figure 3.1.12-2 correspond to the numbers and Class I areas listed in Table 3.1.12-8.

[145] The memorandum and associated guidance use kilometers. 100 kilometers is equal to about 62 miles.
[146] The memorandum and associated guidance use kilometers. 50 kilometers is equal to about 31 miles.

Table 3.1.12-8: Relevant Federal Class I Areas

#[a]	Area	Acreage	State
1	Rocky Mountain NP	263,138	CO
2	Black Canyon of the Gunnison Wilderness	11,180	CO
3	Great Sand Dunes Wilderness	33,450	CO
4	Mesa Verde NP	51,488	CO
5	West Elk Wilderness	61,412	CO
6	Weminuche Wilderness	400,907	CO
7	Rawah Wilderness	26,674	CO
8	Mount Zirkel Wilderness	72,472	CO
9	Maroon Bells-Snowmass Wilderness	71,060	CO
10	La Garita Wilderness	48,486	CO
11	Flat Tops Wilderness	235,230	CO
12	Eagles Nest Wilderness	133,910	CO
13	Canyonlands NP	337,570	UT
14	Arches NP	65,098	UT
15	Wheeler Peak Wilderness	6,027	NM

[a] The numbers correspond to the shaded regions in Figure 3.1.12-2.

Source: (USEPA, 2012a)

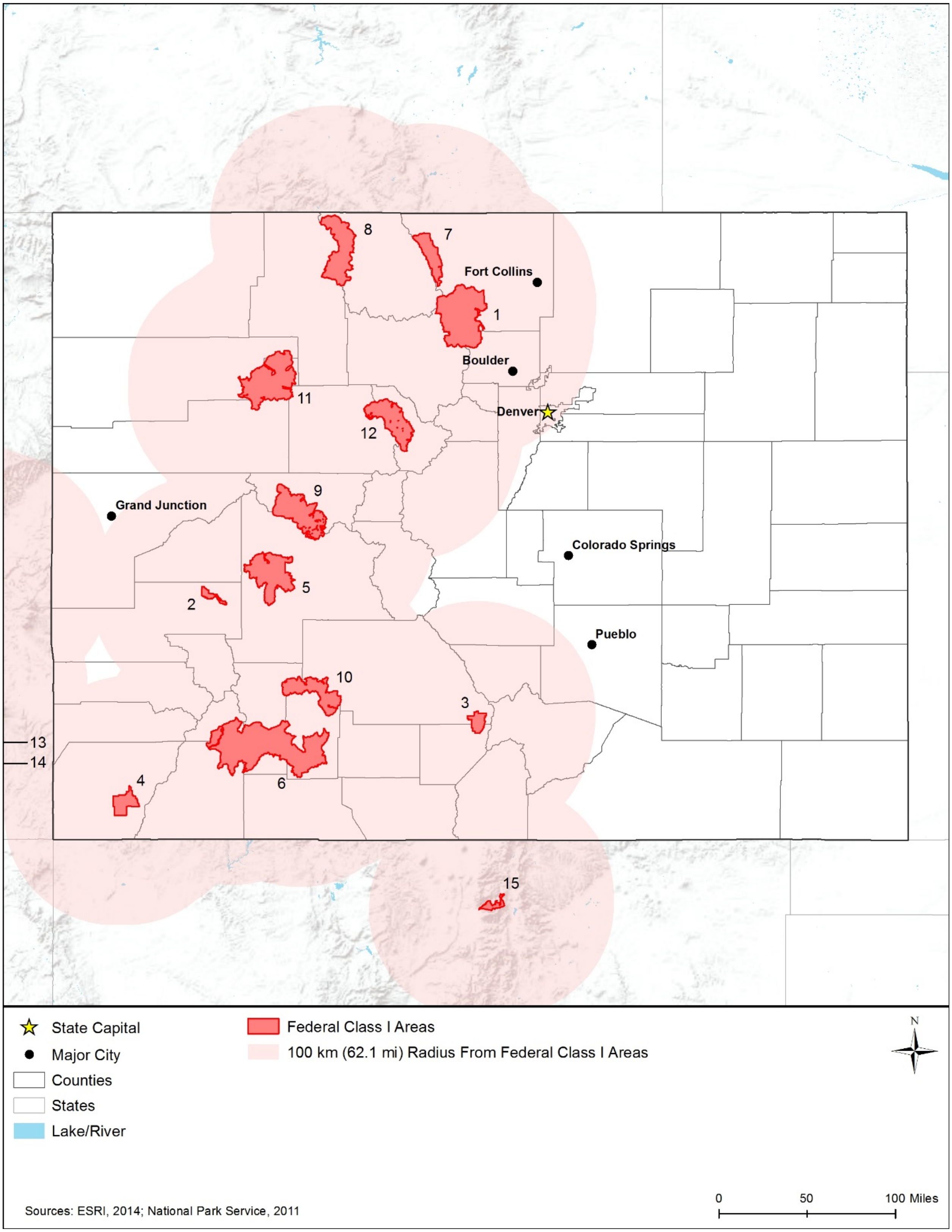

Figure 3.1.12-2: Federal Class I Areas with Implications for Colorado

3.1.13. Noise

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

3.1.13.1. Definition of the Resource

Noise is a form of sound caused by pressure variations that the human ear can detect and is often defined as unwanted sound (USEPA, 2012a). Noise is one of the most common environmental issues that interferes with normal human activities and otherwise diminishes the quality of the human environment. Typical sources of noise that result in this type of interference in urban and suburban surroundings includes interstate and local roadway traffic, rail traffic, industrial activities, aircraft, and neighborhood sources like lawn mowers, leaf blowers, etc.

The effects of noise can be classified into three categories:

- Noise events that result in annoyance and nuisance;
- Interference with speech, sleep, and learning; and
- Physiological effects such as hearing loss and anxiety.

3.1.13.2. 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") (OSHA, 2016b). 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, 2015d). 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, 2016b).

Measurements and descriptions of noise (i.e., sounds) are based on various combinations of the following factors (FTA, 2006):

- The total sound energy radiated by a source, usually reported as a sound power level.
- The actual air pressure changes experienced at a particular location, usually measured as a sound pressure level (SPL) (the frequency characteristics and SPL combine to determine the loudness of a sound at a particular location).
- The duration of a sound.
- The changes in frequency characteristics or pressure levels through time.

Figure 3.1.13-1 presents the sound levels of typical events that occur on a daily basis in the environment. For example, conversational speech is measured at about 55 to 60 dBA, whereas a band playing loud music may be as high as 120 dBA.

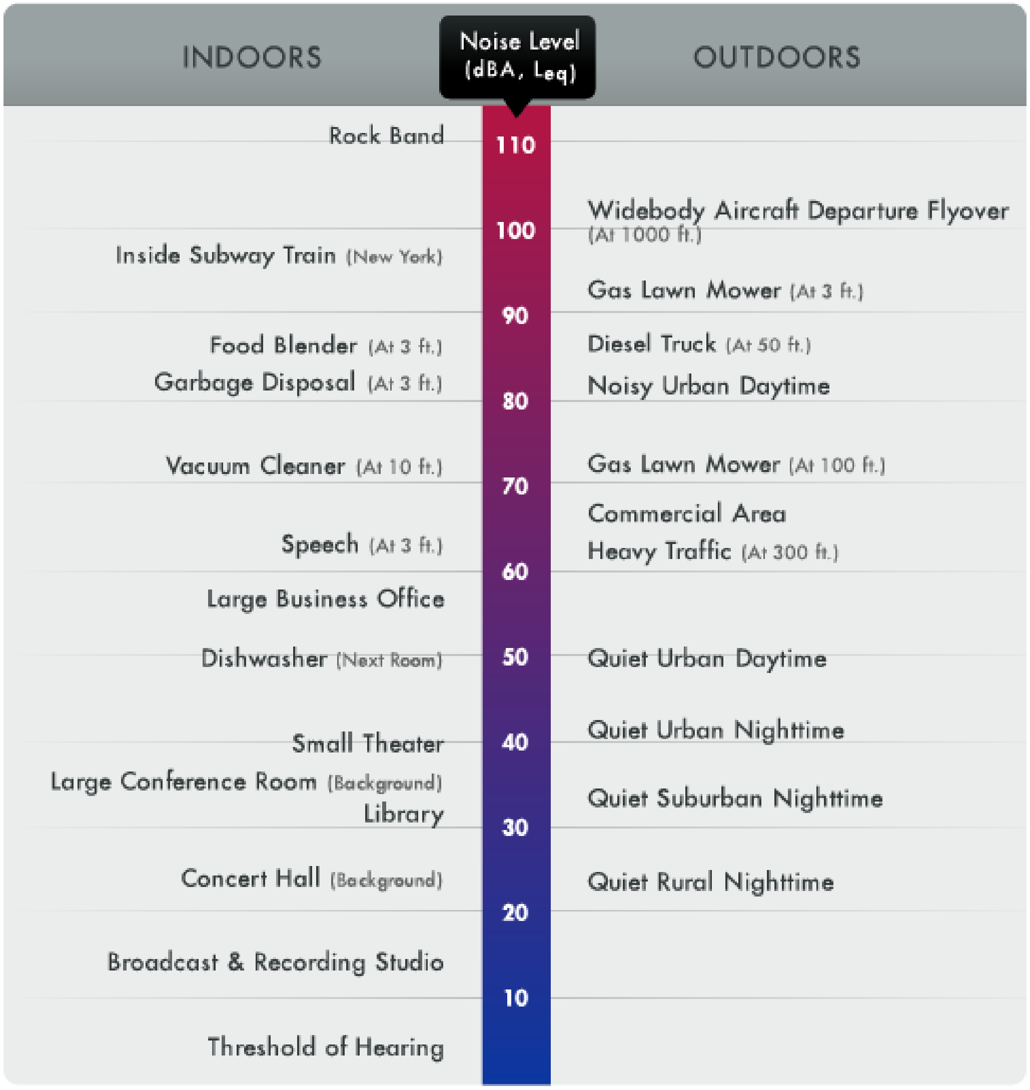

Figure 3.1.13-1: Sound Levels of Typical Sounds

Prepared by: Booz Allen Hamilton

Source: (Sacramento County Airport Systems, 2015)

Because of the logarithmic unit of measurement, sound levels cannot be added or subtracted linearly. However, several methods of estimating sound levels can be useful in determining approximate sound levels. First, if two sounds of the same level are added, the sound level increases by approximately three dB (for example: 60 dB + 60 dB = 63 dB). Secondly, the sum of two sounds of a different level is slightly higher than the louder level (for example: 60 dB + 70 dB = 70.4 dB).

The changes in human response to changes in dB levels is categorized as follows (FTA, 2006):

- A 3-dB change in sound level is considered a barely noticeable difference;
- A 5-dB change in sound level will typically result in a noticeable community response; and
- A 10-dB change, which is generally considered a doubling of the sound level, almost certainly causing an adverse community response.

In general, ambient noise levels are higher during the day than at night and typically this difference is about 10 dB (USEPA, 1973). Ambient noise levels can differ considerably if the environment is urban, suburban, or rural.

3.1.13.3. 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.

Colorado has several statewide noise regulations written into its general and permanent law, which are compiled under the CRS. The Colorado General Assembly under CRS 25-12-101 has approved language that affirms that noise significantly contributes to environmental pollution and harms quality of life. Table 3.1.13-1 provides a brief summary of the specific regulations.

Table 3.1.13-1: Relevant Colorado Noise Laws and Regulations

State Law/ Regulation	Regulatory Agency	Applicability
CRS 25-12-103	Colorado General Assembly	Establishes maximum noise levels specified by time of day and location zone.
CRS 25-12-106	Colorado General Assembly	Establishes maximum noise levels for motor vehicles based on manufactured date and type of vehicle.
CRS 42-4-213	Colorado General Assembly	Requires the use of a siren and horn for emergency vehicles.
CRS 42-4-224	Colorado General Assembly	Requires that motor vehicles using highways be equipped with a horn in good working order that is not unreasonably loud or harsh.
CRS 42-4-225	Colorado General Assembly	Requires that motor vehicles using highways be equipped with a properly maintained muffler.

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 Denver, Colorado Springs, Fort Collins, and Boulder, are likely to have different regulations than rural or suburban communities largely due to the population density and difference in ambient noise levels (FHWA, 2011).

3.1.13.4. Environmental Setting: Ambient Noise

The range and level of ambient noise in Colorado varies widely based on the area and environment of the area. The population of Colorado can choose to live and interact in areas that are large cities, suburban neighborhoods, rural communities, and national and state parks.

- **Urban Environments:** Urban areas are likely to have higher noise levels on a daily basis due to highway traffic (70 to 90 dBA), construction noise (90 to 120 dBA), and outdoor conversations (e.g., small/large groups of people) (60 to 90 dBA) (U.S. Department of Interior, 2008). The urban areas that are likely to have the highest ambient noise levels in the state are Denver, Colorado Springs, Fort Collins, and Boulder.
- **Airports:** Areas surrounding airports tend to have higher noise levels due to aircraft operations that occur throughout the day. A jet engine aircraft can produce between 130 to 160 dBA in its direct proximity (FAA, 2007). However, commercial aircraft are most likely to emit noise levels between 70 to 100 dBA depending of the type of aircraft and associated engine (FAA, 2012). This noise will be perceived differently based on the altitude of the aircraft and its distance to the point of measurement. Airport operations are primarily arrivals and departures of commercial aircraft but based on the type of airport, can include touch-and-go operations that are typical of general aviation airports and military airfields. The location of most commercial airports is in proximity to urban communities, resulting in noise exposure from aircraft operations (arrivals/departures) to the surrounding areas at higher levels and with the potential for increased noise levels during peak operation times (early morning and evenings), when there is an increase in air traffic. The noise levels in areas surrounding commercial airports can have significantly higher ambient noise levels than in other areas. In Colorado, Denver International Airport (DEN) and the City of Colorado Springs Municipal Airport (COS) have combined annual operations of more than 705,554 flights (FAA, 2015f). These operations result in increased ambient noise levels in the surrounding communities. See Section 3.1.1, Public Safety Infrastructure for more information about airports in the state.
- **Highways:** Communities near major highways also experience higher than average noise levels when compared to areas that are not in close proximity to a highway (FHWA, 2015d). There are a number of major highways within the state that may contribute to higher ambient noise levels for residents living near those traffic corridors. The major highways in the state tend to have higher than average ambient noise levels on nearby receptors, ranging from 52 to 75 dBA (FHWA, 2015d). See Section 3.1.1, Public Safety Infrastructure for more information about the major highways in the state.
- **Railways:** Like highways, railways tend to have higher than average ambient noise levels for residents living in close proximity (FTA, 2006). Railroad operations can produce noise ranging from 70 dBA for an idling locomotive to 115 dBA when the locomotive engineer rings the horn while approaching a crossing (FRA, 2015b). Colorado has two major rail corridors with passenger rail traffic. The Colorado section of the California Zephyr route extends from Fort Morgan to Denver, Glenwood Springs, and Grand Junction. The Colorado section of the Southwest Chief route extends from Lamar to Trinidad (CDOT, 2012). See Section 3.1.1, Public Safety Infrastructure for more information about rail corridors in the state.
- **National and State Parks:** The majority of national and state parks are likely to have lower than average ambient noise levels given their size and location in wilderness areas. National

and state parks, historic areas, and monuments are protected areas, 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 10 dBA (NPS, 2014h). Colorado has 13 NPS units and 14 National Natural Landmarks. Visitors to these areas expect lower ambient noise conditions than the surrounding urban areas. See Section 3.1.8, Visual Resources for more information about national and state parks for Colorado.

3.1.13.5. 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, 2014). Most cities, towns, and villages in Colorado have at least one school, church, or park, in addition to likely having other noise-sensitive receptors. There are most likely thousands of sensitive receptors throughout Colorado.

3.1.14. Climate Change

3.1.14.1. Definition of the Resource

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is defined as "…a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or human activity." (IPCC, 2007)

Accelerated rates of climate change are linked to an increase in atmospheric concentrations of greenhouse gas (GHG) caused by emissions from human activities such as burning fossil fuels to generate electricity (USEPA, 2012c). The IPCC is now 95 percent certain that humans are the main cause of current global warming (IPCC, 2013). Human activities result in emissions of four main GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and halocarbons (a group of gases containing fluorine, chlorine, or bromine) (IPCC, 2007). The common unit of measurement for GHGs is metric tons of CO_2-equivalent (MT CO_2e[147]), which equalizes for the different global warming potential of each type of GHG. Where this document references emissions of CO_2 only, the units are in MMT CO_2. Where the document references emissions of multiple GHGs, the units are in MMT CO_2e.

The IPCC reports that global concentrations of these four GHGs have increased significantly since 1750 with atmospheric concentrations of CO_2 increased from 280 parts per million (ppm) of carbon in 1750 to 379 ppm of carbon in 2005 (IPCC, 2007). The atmospheric concentration

[147] CO_2e refers to Carbon Dioxide Equivalent, "A metric measure used to compare the emissions from various greenhouse gases based upon their global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as million metric tons of carbon dioxide equivalents ($MMTCO_2e$). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. $MMTCO_2E$ = (million metric tons of a gas) * (GWP of the gas)." (USEPA, 2015g)

of CH_4 and N_2O have increased from pre-industrial values of about 715 and 270 parts per billion (ppb) to 1774 and 319 ppb, respectively, in 2005 (IPCC, 2007). In addition, the IPCC reports that human activities are causing an increase in various hydrocarbons from near-zero pre-industrial concentrations (IPCC, 2007).

Both the GHG emissions effects of the Proposed Action and Alternatives, and the relationships of climate change effects to the Proposed Action and Alternatives, are considered in this PEIS (see 3.2.14, Environmental Consequences). Existing climate conditions in the project area are described first by state and sub-region, where appropriate, and then by future projected climate scenarios. The discussion focuses on the following climate change impacts: 1) temperature; 2) precipitation/drought; and 3) severe weather events.

3.1.14.2. Specific Regulatory Considerations

The pertinent federal laws relevant to the protection and management of climate change are summarized in Appendix C, Environmental Laws and Regulations. Colorado has established goals and regulations to reduce GHG emissions to combat climate change. As shown in Table 3.1.14.-1, the Colorado Climate Action Plan is the primary policy driver on climate change preparedness and GHG emissions.

Table 3.1.14-1: Relevant Colorado Climate Change Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
Colorado Climate Action Plan (November 2007)	State of Colorado	On November 5, 2007, Colorado Governor Bill Ritter released a climate action plan. The plan establishes a state GHG emissions reduction target: • By 2020, reduce greenhouse gas emissions by 20 percent below 2005 levels; and • By 2050, reduce greenhouse gas emissions by 80 percent below 2005 levels.

3.1.14.3. Colorado Greenhouse Gas Emissions

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

For the purposes of this PEIS, the EIA data on CO_2 emissions are used as the baseline metric to ensure consistency and comparability across the 50 states. However, if additional data sources on GHG emissions are available for a given state, including other GHGs such as CH4, they are described and cited.

According to the EIA, Colorado emitted a total of 90.5 MMT of CO_2 in 2013. The electric power sector was the largest emitter, mostly from coal. The transportation sector is the second-largest emitter, mostly from petroleum products (Table 3.1.14-2) (EIA, 2015e). Annual emissions between 1980 and 2013 are presented in Figure 3.1.14-1. Between 1980 and 2013, Colorado's CO_2 emissions increased from 57.9 MMT/year to a high of 98.0 MMT/year and have since declined, although rising slightly in 2013. Increases over the 1980 baseline occurred in all sectors and from all fuel types. Increases in emissions from coal leveled off and have remained steady beginning in approximately 2001. Emissions from petroleum products leveled off to a slight decline beginning in 2005. Natural gas emissions, while more than doubling between 1980 and 2009 have also begun to decline (Figure 3.1.14-1). Both increases and declines were led by emissions from coal. Recently emissions from natural gas have increased. Emissions from petroleum products have remained relatively constant. Colorado ranked 23rd in total CO2 emissions among the 50 states and the District of Columbia in 2013, and ranked 25th in per capita emissions (EIA, 2015f).

Table 3.1.14-2: Colorado CO_2 Emissions by Fuel Type and Source, 2013

Fuel Type (MMT)		**Source (MMT)**	
Coal	34.3	Residential	8.2
Petroleum Products	30.6	Commercial	3.7
Natural Gas	25.6	Industrial	13.8
		Transportation	26.3
		Electric Power	38.5
Total	**90.5**	**Total**	**90.5**

Source: (EIA, 2015e)

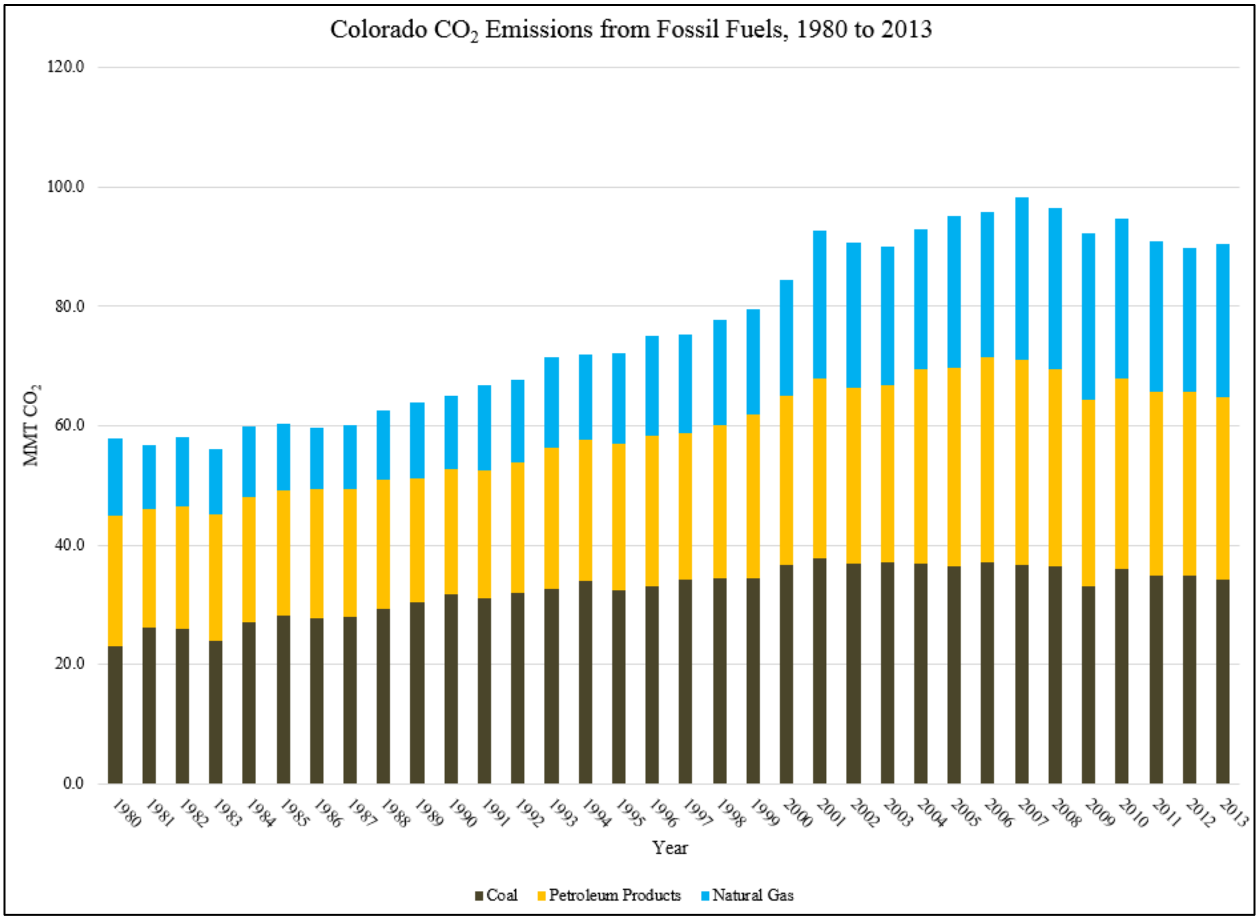

Figure 3.1.14-1: Colorado CO_2 Emissions from Fossil Fuels by Fuel Type 1980-2013

Source: (EIA, 2015e)

The CDPHE maintains a GHG inventory report, most recently updated in 2014. The report estimates the 1990 baseline GHG emissions at 83 MMT CO_2e, 110 MMT CO_2e in 2000, and 130 MMT CO_2e in 2010. For comparison, total U.S. GHG emissions were 6,673 million metric tons (14.7 trillion pounds) in 2013 (USEPA, 2015g). In 2010, CO_2 accounted for 75 percent of total emissions, CH4 for 20 percent, and the remaining five percent consisting of nitrous oxide (N_2O), sulfur hexafluoride (SF_6) and perfluorocarbons (PFCs) (CDPHE, 2014b).

CO_2 emissions are the result of fossil fuel combustion for the purpose of producing energy, mostly petroleum products used in the transportation sector and for home heat, and a growing proportion of natural gas for heat and hot water in residential and commercial buildings (CDPHE, 2014b). With roughly 2 billion barrels of oil extracted in Niobrara, Colorado is one of the largest producers of crude oil in the United States. Colorado has two petroleum refineries that produce gasoline, diesel, and asphalt. Because Colorado has such high demand for petroleum, surrounding states often help supply its market (EIA, 2014b). In 1990, emissions from the industrial sector accounted for 0.8 percent however, emissions increased by 2010 due to “growth in cement manufacturing leakage from Ozone Depleting Substance (ODS) substitute sources.” (CDPHE, 2014b). There are no nuclear power plants in Colorado as the state relies on coal from underground and surface mines to generate electricity. A majority of the coal mined is used for power generation and the rest is exported to surrounding states (EIA, 2014b).

Without the implementation of potential future policy changes, the Colorado GHG Inventory Report projects emissions in Colorado continuing to rise through 2030 to 143 MMT CO_2e.

3.1.14.4. Environmental Setting: Existing Climate

The National Weather Service defines climate as the "reoccurring average weather found in any particular place" (NWS, 2011a). The widely accepted division of the world into major climate categories is referred to as the Köppen-Geiger climate classification system. Climates within this system are classified based "upon general temperature profiles related to latitude" (NWS, 2011a). The first letter in each climate classification details the climate group. The Köppen-Geiger system further divides climates into smaller sub-categories based on precipitation and temperature patterns. The secondary level of classification details the seasonal precipitation, degree of aridity, and presence or absence of ice. The tertiary levels distinguish different monthly temperature characteristics (NWS, 2011b).

Across the United States, the five most common climate groups are (A), (B), (C), (D), and (E). The majority of eastern Colorado falls into climate group (B) (see Figure 3.1.14.4-1). Climates classified as (B) are dry climates, "in large continental regions of the mid-latitudes often surrounded by mountains" (NOAA, 2011). "The most obvious climatic feature of this climate is that potential evaporation and transpiration exceed precipitation" (NOAA, 2011). Whereas the majority of eastern Colorado falls into climate group (B), portions of southern, western, and central Colorado are classified as climate groups (D) and (E) (see Figure 3.1.14.4-1). Climates classified as (D) are "moist continental mid-latitude climates," with "warm to cool summers and cold winters" (NOAA, 2011). 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" (NOAA, 2011). Winter months in (D) climate zones are cold and severe with "snowstorms, strong winds, and bitter cold from Continental Polar or Arctic air masses" (NOAA, 2011). Climates classified as (E) are polar climates, with "year-round cold temperatures with the warmest month less than 50 °F" (NOAA, 2011). Colorado has five sub-climate categories, which are described in the following paragraphs. (NOAA, 2011) (NWS, 2011b)

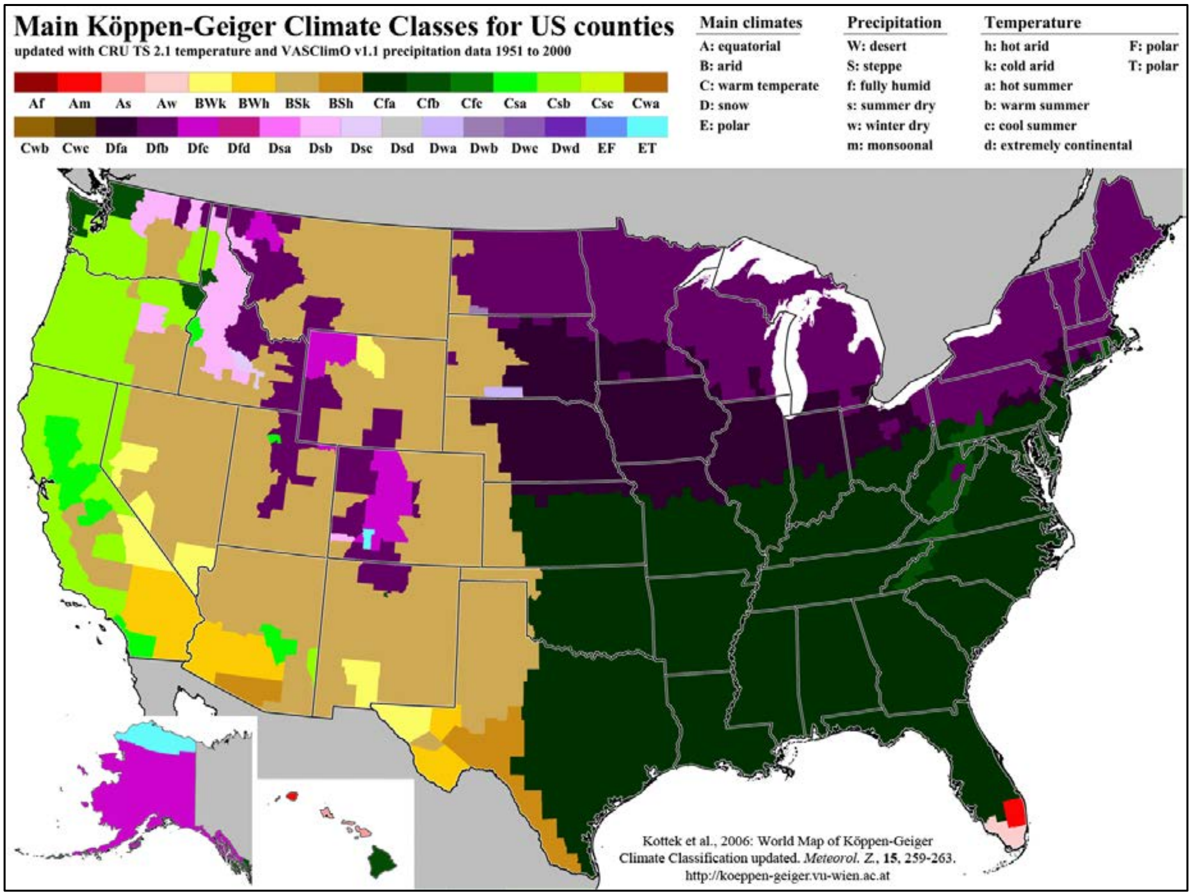

Figure 3.1.14-2: Köppen-Geiger Climate Classes for U.S. Counties

Source: (Kottek, 2006)

Bsk – The Köppen-Geiger climate classification system classifies Denver 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 oF. (NWS, 2011a) (NOAA, 2011) (NWS, 2011b)

Dfb – The Köppen-Geiger climate classification system classifies portions of southern, central, and western Colorado as Dfb. Climates classified as Dfb are characterized as humid, with warm summers and snowy winters. Colorado's secondary classification within this climate zone indicates substantial precipitation during all seasons. (NWS, 2011a) (NOAA, 2011) (NWS, 2011b)

Dfc – The Köppen-Geiger climate classification system classifies portions of central Colorado as (Dfc). Climates classified as Dfc are characterized subarctic, with severe winters, no dry season, and cool summers. Colorado's secondary classification within this climate zone indicates substantial precipitation during all seasons. (NWS, 2011a) (NOAA, 2011) (NWS, 2011b)

Dsb – The Köppen-Geiger climate classification system classifies a minimal area of southwestern Colorado as Dsb. Climates classified as Dsb are characterized as humid continental climates and are found in high altitude areas, "near locations that are warm temperate with dry, hot summers" (GLOBE SCRC, 2015). During winter months, snow in Dsb climates is typically dry. In Dsb climates, at least one month is colder than 26.6 °F and "summers are dry and warm" (GLOBE SCRC, 2015). (NWS, 2011a) (NOAA, 2011) (NWS, 2011b)

Et – The Köppen-Geiger climate classification system classifies a minimal area of southern Colorado as Et. In climates classified as Et, each month out of the year is colder than 32 °F. (GLOBE SCRC, 2015) (NWS, 2011a)

Air Temperature

Colorado is located in the "mid-latitude interior" of the continent and has the "highest average elevation in the United States" averaging 7,000 feet above sea level (Colorado Climate Center 2010) (Doesken 2015). Overall, Colorado is "relatively dry, [with] low humidity and [is] a very sunny state with relatively comfortable temperatures" (Doesken 2015). In addition, Colorado is "far from the moderating effects of the ocean," leading to "large daily and seasonal swings in temperature" (Doesken 2015).

Temperatures in Colorado are strongly influenced by elevation, topography, and latitude. Chinook winds (i.e., westerly winds that blow southward from the eastern slope of the Rocky Mountains) bring "dry, and surprisingly mild air even in midwinter east of the mountains, but can be quickly replaced by cold air coming down across the High Plains from Canada" (Doesken 2015). In these instances, drastic temperature changes of more than 60 °F are not uncommon. Areas of western Colorado are far milder, allowing for vineyards and fruit trees in areas such as Grand Junction and Grand Mesa. (Doesken 2015)

Throughout the state, the average annual mean temperature is approximately 44.8 °F. In southeastern Colorado, temperatures typically reach 104 °F or higher for a few days each summer and reach 100 °F or higher for a few days near Grand Junction, or western Colorado. Temperatures generally cool as you move up in elevation, or towards the mountains. In higher altitude areas (e.g., above 10,000 feet), temperatures rarely surpass 80 °F, "while atop the highest peak only a few days each year see temperatures in the 50's" (Doesken 2015). The highest temperature to occur in Colorado was on July 1, 1933 and July 11, 1954 with a record high of 114 °F (SCEC, 2015). The coldest temperature to occur in Colorado was on February 1, 1985 with a record low of negative 61 °F (SCEC, 2015).

The following paragraphs describe temperature variations as they occur within Colorado's various climate classification zones:

Bsk – Denver, the capital of Colorado, is within the climate classification Bsk. The average annual temperature in Denver is approximately 50.5 °F; 31.0 °F during winter months; 71.4 °F during summer months; 48.3 °F during spring months; and 50.9 °F during autumn months (NOAA, 2015d).

Dfb – Rangely, located in northwestern Colorado, is within the climate classification zone Dfb. The average annual temperature in Rangely is approximately 46.4 °F; 20.2 °F during winter months; 70.5 °F during summer months; 46.9 °F during spring months; and 47.7 °F during autumn months (NOAA, 2015d). Dfb climates in northern Colorado typically experience warm summers, with temperatures ranging between the upper 70s and mid-80s. (NOAA, 2015b) (NOAA, 2015d)

Dfc – Alamosa, located in southern Colorado, is within the climate classification zone Dfc. The average annual temperature in Alamosa is approximately 41.5 °F; 19.9 °F during winter months; 61.2 °F during summer months; 41.8 °F during spring months; and 42.8 °F during autumn months (NOAA, 2015d).

Dsb – Cortez, located in the far southwest corner of Colorado, is within the climate classification zone Dsb. The average annual temperature in Cortez is 50.1 °F; 30.8 °F during winter months; 69.9 °F during summer months; 48.3 °F during spring months; and 50.8 °F during autumn months (NOAA, 2015d).

Et – Gunnison, located in west central Colorado, is within the climate classification zone Et. The average annual temperature in Gunnison is 37.1 °F; 12.3 °F during winter months; 58.6 °F during summer months; 38.0 °F during spring months; and 39.3 °F during autumn months.

Precipitation

The mountains in Colorado have a drastic effect on the state's climate, "producing dramatic local temperature differences and complex precipitation patterns" (Doesken 2015). For example, the high mountain ranges along the Continental Divide help harvest moisture from the Pacific Ocean during the winter months that might otherwise just blow over" (Doesken 2015). In addition, "the mountains also help trigger thunderstorms and occasionally block moisture moving northward from the Gulf of Mexico producing infrequent but sometimes heavy rain over the eastern half of the state" (Doesken 2015).

In addition, Colorado is "unique in its diverse seasonal patterns in precipitation" (Doesken 2015). In mountainous regions of Colorado, the highest accumulations of precipitation occur during mid-winter months and the lowest accumulations of precipitation occur during summer months. By comparison, Eastern Colorado experiences dry winters and wet summers. In the Colorado foothill areas, spring is the wettest season. (Doesken 2015)

The mountains of Colorado also lead to strong rain shadow effects (Doesken 2015). In eastern Colorado, the plains "average between 12 and 18 inches of precipitation annually" (Doesken 2015). "The driest areas are in interior valleys where some locations get less than 10 inches of moisture annually" (Doesken 2015). Colorado's "wettest areas are limited to the higher elevations of the state, the heaviest rainstorms occur at lower elevations especially east of the mountains" (Doesken 2015).

In addition to rainfall, Colorado experiences abundant snowfall, especially in the mountainous regions. In the central Rocky Mountains, "winter begins early and lasts into April and May at the higher elevations with much of the annual precipitation falling as snow" (Doesken 2015). In the Rocky Mountains, annual seasonal snowfall totals range from 75 to 150 inches in the valleys and from 200 to over 500 inches in higher altitudes (Doesken 2015). Lower elevations in the Rockies typically the majority of precipitation as rainfall. West central and southeastern regions of Colorado typically receive less than 25 inches of snowfall on average annually (Doesken

2015). The highest 24-hour snowfall accumulation occurred April 14 through 15, 1921 in Silverlake, with a total accumulation of 75.8 inches (SCEC, 2015).

The following paragraphs describe annual precipitation as it occurs in the various climate classification zones:

Bsk **–** Denver, the capital of Colorado, is within the climate classification Bsk. "May is the wettest month for Denver and northeastern Colorado" (Doesken 2015). The average annual precipitation accumulation in Denver is approximately 14.30 inches; 1.13 inches during winter months; 5.83 inches during summer months; 4.75 inches during spring months; and 2.59 inches during autumn months (NOAA, 2015d).

Dfb **–** Rangely, located in northwestern Colorado, is within the climate classification Dfb. August is typically the wettest month for western regions of Colorado. The average annual precipitation accumulation in Rangely is approximately 11.46 inches; 1.79 inches during winter months; 2.78 inches during summer months; 3.13 inches during spring months; and 3.76 inches during autumn months (NOAA, 2015d).

Dfc **–** Alamosa, located in central south Colorado, is within the climate classification Dfc. The driest city in Colorado is Alamosa. The average annual precipitation accumulation in Alamosa is approximately 7.31 inches; 0.87 inches during winter months; 2.73 inches during summer months; 1.70 inches during spring months; and 2.01 inches during autumn months (NOAA, 2015d). (Doesken 2015)

Dsb **–** Cortez, located in the far southwestern corner of Colorado, is within the climate classification Dsb. "August is often the wettest month for far southwestern Colorado" (Doesken 2015). The average annual precipitation accumulation in Cortez is 12.57 inches; 2.70 inches during winter months; 3.16 inches during summer months; 2.80 inches during spring months; and 3.91 inches during autumn months (NOAA, 2015d).

Et **–** Gunnison, located in west central Colorado, is within the climate classification zone Et. The average annual precipitation accumulation in Gunnison is 10.64 inches; 2.32 inches during winter months; 3.67 inches during summer months; 2.06 inches during spring months; and 2.59 inches during autumn months.

Severe Weather Events

Heavy downpours in Colorado are uncommon, but are "possible anytime from March and April into early October" (Doesken 2015). The highest total rainfall accumulation to occur was near the Kansas border in May 1935, where approximately 24 inches fell in a 24-hour period (Doesken 2015). Although extreme precipitation events in Colorado are rare, the state does have a "history of dangerous flash floods" (Doesken 2015). For example, in 1976 "an intense late July storm over the eastern foothills dropped over 10 inches of rain west of Loveland" (Doesken 2015). This heavy rainfall resulted in "the infamous Big Thompson Canyon flash flood that claimed at least 140 lives" (Doesken 2015). In 1997, another severe flooding event occurred, resulting in "more than 12 inches of rain fell in a few hours over portions of the City of Fort Collins" (Doesken 2015).

In addition to flooding, close proximity to the mountains and "high elevation plains create an ideal environment for summer thunderstorm development when sufficient humidity is present" (Doesken 2015). Especially within areas of eastern Colorado, late spring, and summer, storms can be severe. Areas of Colorado are also, among "the nation's most hail prone areas with several areas averaging over six hail days per year" (Doesken 2015). Although Colorado is not classified as being within the nation's "Tornado Alley," tornados in Colorado do occur, and can be very severe. (Doesken 2015)

3.1.15. Human Health and Safety

3.1.15.1. Definition of the Resource

The existing environment for health and safety is defined by occupational and environmental hazards likely to be encountered during the deployment, operation, and maintenance of towers, antennas, cables, utilities, and other equipment and infrastructure at existing and potential FirstNet telecommunication sites. There are two human populations of interest within the existing environment of health and safety, (1) telecommunication occupational workers and (2) the general public near telecommunication sites. Each of these populations could experience different degrees of exposure to hazards as a result of their relative access to FirstNet telecommunication sites and their function throughout the deployment of the FirstNet telecommunication network infrastructure.

The health and safety issues reviewed in this section include occupational safety for telecommunications workers, contaminated sites, and manmade or natural disaster sites. This section does not evaluate the health and safety risks associated with radio frequency radiation or vehicle traffic.

3.1.15.2. Specific Regulatory Considerations

Federal organizations, such as the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), USEPA, the U.S. Department of Health and Human Services, and others protect human health and the environment. In Colorado, this resource area is regulated by the Colorado Department of Labor and Employment (CDLE), and the Colorado Department of Public Health & Environment (CDPHE) regulates waste and environmental pollution, as well as health and safety of the general public. Federal OSH regulations apply to workers through either OSHA, or stricter state-specific plans that must be approved by OSHA. Colorado does not have an OSHA-approved "State Plan." Therefore, public and private sector occupational safety and health programs in the state of Colorado are enforced by OSHA.

Federal laws relevant to protecting occupational and public health and safety are summarized in Appendix C, Environmental Laws and Regulations. Table 3.1.15-1 summarizes the major Colorado laws relevant to the state's occupational health and safety, hazardous materials, and hazardous waste management programs.

Table 3.1.15-1: Relevant Colorado Human Health and Safety Laws and Regulations

State Law/Regulation	Regulatory Agency	Applicability
CRS 25-16-303	CDPHE	Provides for the cleanup of contaminated sites, which are not listed as a federal Superfund site, to bring properties into "economic benefit."

3.1.15.3. Environmental Setting: Existing Telecommunication Sites

There are many inherent health and safety hazards at telecommunication sites. Telecommunication site work is performed indoors, below ground level, on building roofs, over water bodies, and on communication towers. Tasks are often 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, 2015a). In addition to tower climbing hazards, telecommunication workers have restricted workspace on rooftops or work from bucket trucks parked on uneven ground. Cumulatively, these conditions present fall and injury hazards to telecommunication workers, and the general public who may be observing the work or transiting the area (IFC, 2007a).

Trenches and confined spaces – In rare cases, FirstNet deployment, operation, and maintenance activities may involve work in trenches or confined spaces. Installation of telecommunication activities involves laying conduit and limited trenching (generally 6 to 12 inches in width). Confined space work can involve poor atmospheric conditions, requiring ventilation and rescue equipment. Additionally, when inside a confined space, worker movement is restricted and may prevent a rapid escape or interfere with proper work posture and ergonomics. The general public can be at risk of stepping or driving motor vehicles into open trenches, or falling into uncovered confined spaces. (OSHA, 2016a)

Heavy equipment and machinery – New and replacement facility construction 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, 2016a)

Energized equipment and existing utilities – Electrical shock from energized equipment and utilities is an elevated risk at telecommunication sites due to the amount of electrical energy required for powering communication equipment and broadcasting towers. Telecommunication cables are often co-located with underground and overhead utilities, which can further increase occupational risk during earth-breaking and aerial work. (IFC, 2007a)

Optical fiber safety – Optical fiber cable installation and repair presents additional risks to telecommunications workers, including potential eye or tissue damage, through ingestion, inhalation, or other contact with glass fiber shards. The shards are generated during termination and splicing activities, and can penetrate exposed skin (IFC, 2007a). Additionally, fusion splicing (to join optical fibers) in confined spaces or other environments with the potential for flammable gas accumulation presents risk of fire or explosion (Fiber Optic Association, 2010).

Noise – Sources of excess noise at telecommunication sites include heavy equipment operation, electrical power generators and other small engine equipment, air compressors, electrical and pneumatic power tools, and road vehicles, such a diesel engine work trucks. The cumulative noise environment has the potential to exceed the OSHA acceptable level of 85 decibels (dB) per 8-hour time weighted average (TWA) (see Section 3.1.13, Noise) (OSHA, 2015b). 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, 2016a).

Hazardous materials and hazardous waste – Work at telecommunication sites requires the storage and use of hazardous materials such as fuel sources for backup power generators, 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 paint on outdoor structures or asbestos tiles and insulation in equipment sheds. The general public, unless a telecommunication work site allows unrestricted access, are typically shielded from hazardous materials and hazardous wastes that are components of telecommunication site work. (OSHA, 2016a)

Aquatic environments – Installation of telecommunication lines may include laying, burying, or boring lines under waterways and wetlands, such as lakes, rivers, ponds, or 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, 2016a)

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, 2016a)

Telecommunication Worker Occupational Health and Safety

The U.S. Department of Labor, Bureau of Labor Statistics (BLS) uses established industry and occupational codes to classify telecommunications workers. For industry classifications, BLS uses the North American Industry Classification System (NAICS) codes, which identify the telecommunications industry (NAICS code 517XX) as being within the information industry (NAICS code 51). For occupational classifications, BLS uses the Standard Occupational Classification (SOC) system to identify workers as belonging to one of 840 occupations. Telecommunications occupations are identified as both telecommunication equipment installers and repairers, except line installers (SOC code 49-2022), or telecommunication line installers and repairers (SOC code 49-9052). Both occupations are reported under the installation, maintenance and repair occupations (SOC code 49-0000).

As of May 2015, there were 4,610 telecommunication equipment installers and repairers, and 1,750 telecommunication line installers and repairers working in Colorado (BLS, 2015a). BLS data related to nonfatal occupational injuries or illnesses is not available for Colorado (BLS, 2015b). Nationwide, there were 1.4 nonfatal occupational injury cases per 100 full-time workers in the telecommunications industry (BLS, 2014a).

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, 2013). This represents 45 percent of the broader information industry fatalities (40 total), and less than 1 percent of occupational fatalities (4,585 total). Colorado has not had any fatalities in the telecommunications industry or telecommunications occupations since 2003, when data were first reported (BLS, 2015c). In the broader installation, maintenance, and repair occupations (SOC code 49-0000), there were 87 fatalities in Colorado between 2003 and 2013, including 8 fatalities[148] in 2014; the highest fatality year was 2003, with 11 fatalities (BLS, 2015d).

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

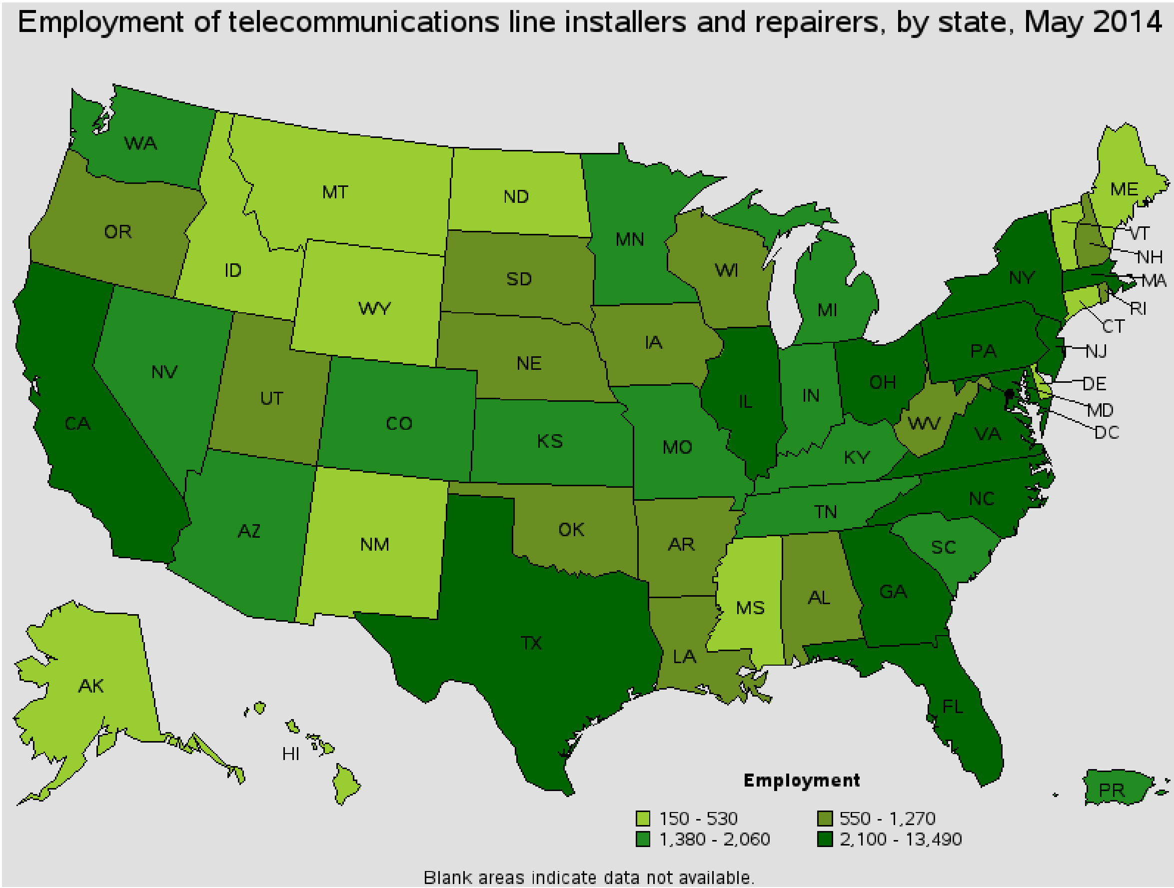

Figure 3.1.15-1: Number of Telecommunication Line Installers and Repairers Employed per State, May 2014

Source: (BLS, 2015e)

Public Health and Safety

The general public is unlikely to encounter occupational hazards at telecommunication sites, due to limited access. CDPHE collects injury surveillance and fatality data among the general public through the Colorado Health Information Dataset (CoHID). While the CoHID cannot be searched for cases specific to telecommunication sites, many available injury categories are consistent with risks present at telecommunication sites. For example, between 2000 and 2014, there were 1,215 injuries from being caught in or between objects and 482 injuries from electric shock (CDPHE, 2014c). Among the general public, trespassers entering telecommunication sites would be at the greatest risk for exposure to health and safety hazards.

3.1.15.4. Contaminated Properties at or near Telecommunication Sites

Existing and surrounding land uses, including landfills or redeveloped brownfields, near telecommunication sites have the potential to impact human health and safety. Furthermore, undocumented environmental practices of telecommunication site occupants at telecommunication sites, prior to the creation of environmental laws, could result in environmental contamination, affecting the quality of soil, sediments, groundwater, surface water, and air.

Contaminated property is typically classified by the federal environmental remediation or cleanup programs that govern them, such as sites administered through the Superfund Program[149] or listed on the National Priorities List, 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.

In Colorado, the CDPHE provides oversight to USEPA superfund sites in the state (CDPHE, 2015o). However, Colorado does not have a state Superfund program. As of October 2015, Colorado had 43 RCRA Corrective Action sites,[150] 504 brownfields, and 20 proposed or final Superfund/NPL sites (USEPA, 2015h). Based on a September 2015 search of USEPA's Cleanups in My Community (CIMC) database, there are three Superfund sites in Colorado where contamination has been detected at an unsafe level, or a reasonable human exposure risk exists (California Gulch, near Leadville, CO; Central City, near Idaho Springs, CO; and Standard Mine, near Crested Butte, CO) (USEPA, 2015i). Colorado's Brownfields Program and Voluntary Cleanup Program offer incentives for the remediation and redevelopment of contaminated properties, which would otherwise hinder economic progress (CDPHE, 2015p).

In addition to contaminated properties, certain industrial facilities are permitted to release toxic chemicals into the air, water, or land. One such program is the Toxics Release Inventory (TRI), administered by the USEPA under the Emergency Planning and Community Right to Know Act (EPCRA) of 1986. The TRI database is a measure of the industrial nature of an area and the over-all chemical use, and can be used to track trends in releases over time. The "releases" do not necessarily equate to chemical exposure by human beings or necessarily constitute to quantifiable health risks because the releases include all wastes generated by a facility – the majority of which are disposed of via managed, regulated processes that minimize human exposure and related health risks (e.g., in properly permitted landfills or through recycling facilities). As of December 2015, Colorado had 238 TRI reporting facilities. The identification of a TRI facility does not necessarily indicate that the facility is actively releasing to the environment; the majority of TRI reports involve permitted disposal facilities. According to the USEPA, in 2013, the most recent data available, Colorado released 27.6 million pounds of toxic chemicals through onsite and offsite disposal, transfer, or other releases, largely from the metal

[149] 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).

[150] Data gathered using the U.S. Environmental Protection Agency's Cleanups in My Community (CIMC) search on October 5, 2015, for all sites in the state of Colorado, where cleanup type equals 'RCRA Hazardous Waste – Corrective Action,' and excludes sites where cleanup phase equals 'Construction Complete' (i.e., no longer active) (USEPA, 2013b).

mining industry. This accounted for 0.67 percent of nationwide TRI releases, ranking Colorado 45 of 56 states and territories based on total releases per square mile (USEPA, 2015j).

Another USEPA program is the National Pollutant Discharge Elimination System (NPDES), which regulates the quality of stormwater and sewer discharge from industrial and manufacturing facilities. Permitted discharge facilities are potential sources of toxic constituents that are harmful to human health or the environment. As of October 15, 2015, Colorado had 134 major NPDES permitted facilities registered with the USEPA Integrated Compliance Information System (USEPA, 2015k).

The National Institute of Health, U.S. National Library of Medicine, provides an online mapping tool called TOXMAP, which allows users to "visually explore data from the USEPA's TRI and Superfund Program" (NIH, 2015a). Figure 3.1.15-2 provides an overview of potentially hazardous sites in Colorado.

Telecommunication Worker Occupational Health and Safety

Telecommunications sites may be on or near contaminated land, industrial discharge facilities, or sites presenting additional hazards. Occupational exposure to contaminated environmental media can occur during activities like soil excavating, trenching, other earthwork, and working over water bodies. Indoor air quality may also be impacted from vapor intrusion infiltrating indoors from contaminated soil or groundwater that are present beneath a building's foundation. As of October 2015, there are 182 USEPA-regulated telecommunications sites in Colorado (USEPA, 2015l). These sites are regulated under one or more environmental programs including NPDES compliance, Superfund/NPL status, and TRI releases.

According to BLS data, Colorado has not reported fatalities within the telecommunications industry or telecommunications occupations since 2003, when data are first available (BLS, 2015b). The BLS reported three fatalities in 2011 and three fatalities in 2014 nationwide within the telecommunications industry (NAICS code 517), due to exposure to harmful substances or environments. (BLS, 2015f). In 2014, BLS also reported four fatalities within the telecommunications line installers and repairers' occupation (SOC code 49-9052), and no fatalities within the telecommunications equipment installers and repairers' occupation (SOC code 49-2022) due to exposure to harmful substances or environments (BLS, 2014b).

Public Health and Safety

As described earlier, access to telecommunications sites is nearly always restricted to occupational workers. Although site access control is one of the major reasons telecommunications sites present an inherent low risk to non-occupational workers, the general public could be potentially exposed to contaminants and other hazards in a variety of ways. One example would be if occupational workers disturb contaminated soil while digging, causing hazardous chemicals to mix with an underlying groundwater drinking water sources. If a contaminant enters a drinking water source, the surrounding community could inadvertently ingest or absorb the contaminant when using that source of water for drinking, cooking, bathing, and swimming. By trespassing on a restricted property, a trespasser may come in contact with contaminated soil or surface water, or by inhaling harmful vapors. The CDPHE is responsible for collecting public health data resulting from exposure to environmental contamination, and provides publicly available health assessments and consultations for documented hazardous waste sites (CDPHE, 2015q).

Spotlight on Colorado Superfund Sites: Standard Mine Site

The Standard Mine Site, located in Gunnison National Forest, Gunnison County, CO, is a 10-acre silver mine that operated from 1874 until 1974. As waste rock piles from the mine were exposed to air and water, they formed acidic water that collected on the site, releasing heavy metals from the rock. The water flowed from the site into nearby Elk Creek and eventually into Coal Creek, which is a drinking water source for downstream populations. The USEPA addressed contamination at the site by rechanneling Elk Creek, excavating, and disposing of contaminated materials, and installation of a water treatment system. Current human health and safety exposure risks are present through ingestion or direct contact with contaminated soil, surface water, and groundwater; however, short-term exposure pathways are under control (USEPA, 2016i).

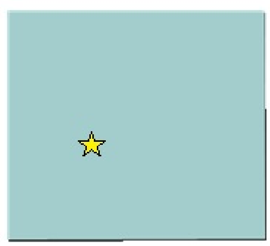

Figure 3.1.15-2: Standard Mine Superfund Site, July 2005

Source: (University of Colorado Boulder, 2007)

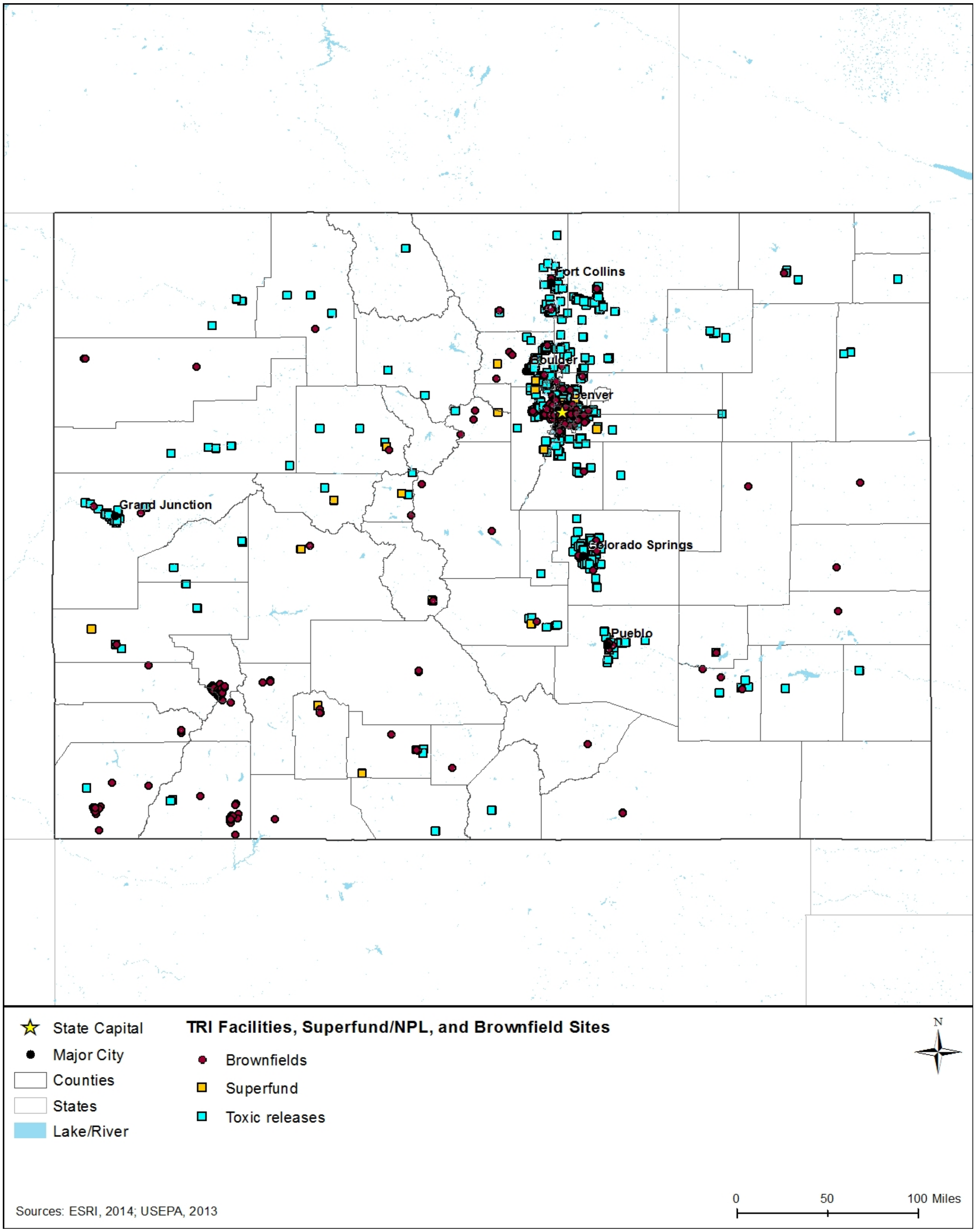

Figure 3.1.15-3: TOXMAP Superfund/NPL and TRI Facilities in Colorado (2013)

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

Another health and safety hazard in Colorado includes surface and subterranean mines. In 2015, the Colorado mining industry ranked 12th for non-fuel minerals (molybdenum, gold, sand and gravel, portland cement, and crushed stone), generating a value of $2.41B (USGS, 2016b). In 2013, Colorado had 11 coalmining operations (7 underground and 4 surface) (EIA, 2013). Health and safety hazards at active mines and abandoned mine lands include falling into open shafts, cave-ins from unstable rock and decayed support, deadly gases and lack of oxygen inside the mine, unused explosives and toxic chemicals, horizontal and vertical openings, high walls, and open pits (BLM, 2015f). Abandoned uranium mines in Colorado pose additional health and safety hazards (Colorado Division of Reclamation Mining & Safety, 2015a). In addition to health and safety hazards associated with non-uranium mines, uranium extraction activities also produce mill tailings, a radioactive waste material containing heavy metals and radium (U.S. Nuclear Regulatory Commission, 2015).

The Colorado Department of Natural Resources, Division of Reclamation Mining and Safety, Inactive Mine Reclamation Program administers mine reclamation projects funded by grants from the Surface Mining Control and Reclamation Act (SMCRA). The AML section is responsible for managing AML health and safety hazards resulting from pre-1977 mining operations. The Division of Reclamation Mining & Safety estimates there are approximately 23,000 abandoned mines in the state of Colorado (Colorado Division of Reclamation Mining & Safety, 2015b). Figure 11.1.15-4 shows the distribution of High Priority (Priority 1, 2 and adjacent Priority 3) AMLs in Colorado, 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 October 2015, Colorado had 764 Priority 1 and 2 AMLs, with 132 unfunded problem areas (DOI, 2015a).

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often called upon to provide support to natural and manmade disaster response efforts because of the critical need to restore and maintain telecommunication capabilities. Telecommunications sites may be on or near AMLs or coalmine 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 coalmines 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, coalmine fires can consume enough sub-surface material, that risk of subsidence increases. As a result, AMLs and coalmine fires in particular, can result in evacuations of entire communities (DOI, 2015c). Colorado promotes a "Stay Out, Stay Alive" program, to educate the public of the dangers of abandoned mines (Colorado Division of Reclamation Mining & Safety, 2015c).

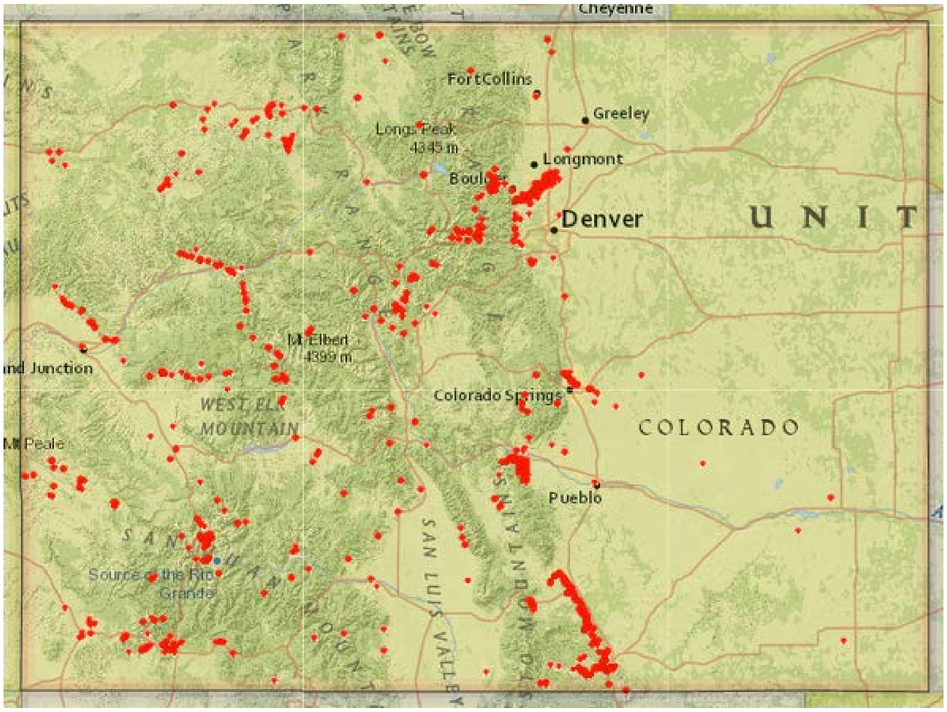

Figure 3.1.15-4: High Priority Abandoned Mine Lands in Colorado (2015)

Source: (DOI, 2015b)

3.1.15.6. Environmental Setting: Natural and Manmade Disaster Sites

Natural and manmade disaster events can create health and safety risks, as well as present unique hazards, to telecommunication workers and the general public. Telecommunications, including public safety communications, can be unavailable (temporarily or permanently) during disaster events. Examples of manmade disasters are train derailments, refinery fires, or other incident involving the release of hazardous constituents. A common example of a natural disaster is flooding. Floodwaters damage transportation infrastructure (roads, railways, etc.) and utility lines (sewer, water, electric power, broadband, natural gas lines, etc.). 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). High-risk targets for terror attacks include government centers, military bases, industrial facilities, and airfields, etc. As such, the District of Columbia presents an inherent risk for this type of disaster.

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, and falls. During natural and manmade disasters, access to the telecommunication sites can be obstructed by debris.

Telecommunication Worker Occupational Health and Safety

Telecommunication workers are often early responders to natural and manmade disasters because of the critical need to restore and maintain telecommunication capabilities. The need to enter disaster areas as part of the recovery effort exposes telecommunication workers to elevated risks because chemical, biological, and physical hazards might not have not been fully identified or assessed. Transportation infrastructure and utilities in the affected areas are often compromised and present unknown chemical and biologic hazards. Correspondingly, if telecommunication workers are injured during response and repair operations, their rescue and treatment might over-extend first responder staff and medical facilities that are delivering care to victims of the initial incident.

Currently, CDPHE 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 218 NRC-reported incidents for Illinois in 2015 with known causes, 11 incidents were attributed to natural disaster (e.g., natural phenomenon); while 207 incidents were attributed to manmade disasters (e.g., derailment, dumping, equipment failure, operator error, over pressuring, transport accident, or trespasser) or other indeterminate causes (U.S. Coast Guard, 2015). For example, in April 2013, a tractor trailer collided with landslide debris from a nearby mountainside in Garfield County along Interstate. Both fuel tanks of the truck were ruptured, releasing about 20 gallons of fuel, some of which made its way into the nearby Colorado River (U.S. Coast Guard, 2012). Such incidents present unique, hazardous challenges to telecommunication workers during natural and manmade disasters.

Public Health and Safety

Hazards present during natural and manmade disasters are often far-reaching, affecting large geographic areas and affecting all populations living within the area. Similar to telecommunication workers, the general public faces risks during these types of disasters, such as compromised transportation infrastructure and utilities, potential for exposure to unknown chemical and biologic hazards, and inadequate medical support. In 2014, Colorado experienced 20 weather-related injuries and ten fatalities. By comparison, 384 weather-related fatalities and 2,203 injuries were reported nationwide the same year. (NWS, 2015).

Spotlight on Colorado Manmade Disaster Sites: Animas River Spill

The Gold King mine near Silverton, CO, produced gold, silver, lead, and copper until decommissioning in 1991. On August 5, 2015, during USEPA mitigation activities at the closed mine excavation above the mine's adit accidently released 3 million gallons of metal-contaminated wastewater that had been plugged inside the mine. Soon afterward, the contaminated water entered a tributary of the Animas River and caused discoloration (USEPA, 2016g). CDPHE notified downstream water users to prepare themselves by turning off water intakes until the contamination was flushed through the river (CDPHE, 2016b). The extent of the release, along with the observed discoloration of the river, drew attention from news outlets and sparked anxiety from the public. Since the spill, the CDPHE and the Colorado Department of Agriculture have notified the public that water from the river has returned to pre-release levels, and crops and livestock in the area are safe to consume (CDPHE, 2015d).

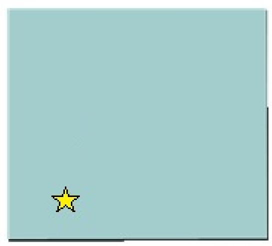

Figure 3.1.15-5: USGS Scientists Monitor the Animas River

Source: (USGS, 2014j)

3.2. Environmental Consequences

This section describes the potential environmental impacts, beneficial, or adverse, resulting from the Proposed Action and Alternatives. As this is a programmatic evaluation, site- and project-specific issues are not assessed. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Each resource area identifies the range of possible impacts on resources for the Proposed Action and Alternatives, include the No Action Alternative. The No Action Alternative provides a comparison to describe the effects of environmental resources of the existing conditions to the proposed Alternatives.

NEPA requires agencies to assess the potential direct and indirect impacts each alternative could have on the existing environment (as characterized earlier in this section). Direct impacts are those impacts that are caused by the Proposed Action and occur at the same time and place, such as soil disturbance as a result of construction. Indirect impacts are those impacts related to the Proposed Action but result from an intermediate step or process, such as changes in surface water quality because of soil erosion.

For each resource, the potential impact is assessed in terms of context of the action and the intensity of the potential impact, per CEQ regulations (40 CFR §1508.27). *Context* refers to the timing, duration, and where the impact could potentially occur (i.e., local vs. national; pristine vs. disturbed; common species vs. protected species). In terms of duration of potential impact, context is described as short or long term. *Intensity* refers to the magnitude or severity of the effect as either beneficial or adverse. Resource-specific significance rating criteria are provided at the beginning of each resource area section.

3.2.1. Infrastructure

3.2.1.1. Introduction

This section describes potential impacts to infrastructure in Colorado associated with construction, deployment, and operation of the Proposed Action and Alternatives. Chapter 19, Best Management Practices and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.1.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on infrastructure were evaluated using the significance criteria presented in Table 3.2.1-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to infrastructure addressed in this section are presented as a range of possible impacts.

Table 3.2.1-1: Impact Significance Rating Criteria for Infrastructure

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Transportation system capacity and safety	Magnitude or Intensity	Creation of substantial traffic congestion/delay and/or a substantial increase in transportation incidents (e.g., crashes, derailments).	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in traffic congestion/delay and/or transportation incidents (e.g., crashes, derailments).	No effect on traffic congestion or delay, or transportation incidents.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Permanent: Persisting indefinitely.		Short-term effects will be noticeable for up to the entire construction phase or a portion of the operational phase.	NA
Capacity of local health, public safety, and emergency response services	Magnitude or Intensity	Impacted individuals or communities cannot access health care and/or emergency services, or access is delayed, due to the project activities.	Effect is potentially significant, but with mitigation is less than significant.	Minor delays to access to care and emergency services that do not impact health outcomes.	No impacts on access to care or emergency services.
	Geographic Extent	Regional impacts observed (“regional” assumed to be at least a county or county-equivalent geographical extent, could extend to state).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Duration is constant during construction and deployment phase.		Rare event during construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Modifies existing public safety response, physical infrastructure, telecommunication practices, or level of service in a manner that directly affects public safety communication capabilities and response times	Magnitude or Intensity	Substantial adverse changes in public safety response times and the ability to communicate effectively with and between public safety entities.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal change in the ability to communicate with and between public safety entities.	No perceptible change in existing response times or the ability to communicate with and between public safety entities.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Permanent or perpetual change in emergency response times and level of service.		Change in communication and/or the level of service is perceptible but reasonable to maintaining effectiveness and quality of service.	NA
Effects to commercial telecommunication systems, communications, or level of service	Magnitude or Intensity	Substantial adverse changes in level service and communications capabilities.	Effect that is potentially significant, but with mitigation is less than significant.	Minor changes in level of service and communications while transitioning to the new system.	No perceptible effect to level of service or communications while transitioning to the new system.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Persistent, long-term, or permanent effects to communications and level of service.		Minimal effects to level of service or communications lasting no more than a short period (minutes to hours) during the construction and deployment phase.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects to utilities, including electric power transmission facilities and water and sewer facilities	Magnitude or Intensity	Substantial disruptions in the delivery of electric power or to physical infrastructure that results in disruptions, including frequent power outages or drops in voltage in the electrical power supply system ("brownouts"). Disruption in water delivery or sewer capacity, or damage to or interference with physical plant facilities that impact delivery of water or sewer systems.	Effect that is potentially significant, but with mitigation is less than significant.	Minor disruptions to the delivery of electric power, water, and sewer services, or minor modifications to physical infrastructure that result in minor disruptions to delivery of power, water, and sewer services.	There would be no perceptible impacts to delivery of other utilities and no service disruptions.
	Geographic Extent	Local/City, County/Region, or State/Territory.		Local/City, County/Region, or State/Territory.	Local/City, County/Region, or State/Territory.
	Duration or Frequency	Effects to other utilities would be seen throughout the entire construction phase.		Effects to other utilities would be of short duration (minutes to hours) and would occur sporadically during the entire construction phase.	NA

NA = Not Applicable

3.2.1.3. Description of Environmental Concerns

Transportation System Capacity and Safety

The primary concerns for transportation system capacity and safety related to FirstNet activities would primarily occur during the construction phases of deployment. Depending on the exact site locations and placement of new assets in the field, temporary impacts on traffic congestion, railway use, airport operations, or use of other transportation corridors could occur if site locations were near or adjacent to roadways and other transportation corridors, requiring temporary closures (lane closures on roadways, for example). Coordination could be necessary with the relevant transportation authority (i.e., CDOT, airport authorities, and railway companies) to ensure proper coordination during deployment. Based on the impact significance criteria presented in Table 3.2.1-1, such impacts would be less than significant due to the temporary nature of the deployment activities, even if such impacts would be realized at one or more isolated locations. Such impacts would be noticeable during the deployment phase, but would be short-term, with no anticipated impacts continuing into the operational phase, unless any large-scale maintenance would become necessary during operations.

Capacity of Local Health, Public Safety, and Emergency Response Services

The capacity of local health, public safety, and emergency response services would experience less than significant impacts during 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 – and that is if emergency response services were using transportation infrastructure to respond to an emergency at the exact time that deployment activities were taking place. This type of impact would be isolated at the local or neighborhood level, and the likelihood of such an impact would be extremely low. Once operational, the new network would provide beneficial impacts to the capacity of local health, public safety, and emergency response services through enhanced communications infrastructure, thereby increasing capacity for and enhancing the ability of first responders to communicate during emergency response situations. Based on the impact significance criteria presented in Table 3.2.1-1, potential negative impacts would be less than significant. Substantial beneficial impacts are likely to result from implementation.

Modifies Existing Public Safety Response Telecommunication Practices, Physical Infrastructure, or Level of Service in a manner that directly affects Public Safety Communication Capabilities and Response Times

The Proposed Action and alternatives contemplated by FirstNet would not cause negative impacts to existing public safety response telecommunication practices, physical infrastructure, or level of service in a manner that directly affects public safety communication capabilities and response times. Based on the impact significance criteria presented in Table 3.2.1-1, any potential impacts would be less than significant during deployment. As described above, during deployment and system optimization, existing services would likely remain operational in a redundant manner ensuring continued operations and availability of services to the public. Once operational, state, and local public safety organizations would need to evaluate telecommunication practices and standard operating procedures (SOPs). FirstNet's mission is to complement such practices and SOPs in a positive manner; therefore, only beneficial or complementary impacts would be anticipated. Public safety communication capabilities and response times would be expected to also experience beneficial impacts through enhanced communications abilities. It is possible that FirstNet would be upgrading physical telecommunications infrastructure, thus the infrastructure would also experience a positive and beneficial impact. Disposal or reuse of old public safety communications infrastructure would also likely need to be considered once the specifics are known. Any negative impacts would be expected to be less than significant given the short-term nature of the deployment activities.

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

Commercial telecommunication systems, communications, or level of service would experience no impacts, as such commercial assets would be using a different spectrum for communications. FirstNet has exclusive rights to use of the assigned spectrum, and only designated public safety organizations would be authorized to connect to FirstNet's network. Depending on the use patterns of FirstNet's spectrum, such spectrum use may be over-built or under-utilized.[151] Anticipated impacts would be less than significant due to the limited extent and temporary nature of the deployment.

Effects to Utilities, including Electric Power Transmission Facilities, and Water and Sewer Facilities

The activities proposed by FirstNet would have less than significant impacts on utilities, including electric power transmission facilities, and water and sewer facilities. Depending on the specific project contemplated, installation of new equipment could require connection with local electric sources, and use of site-specific local generators, on a temporary or permanent basis. Also, depending on the specific project contemplated, the draw or use of power from the transmission facilities may need to be examined; however, it is not anticipated that such use of power would have negative impacts, due to the local nature of the proposed activities and the widespread availability and use of the power grid in the United States.

3.2.1.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure.

[151] 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.

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 to infrastructure resources because there would be no ground disturbance and no interference with existing utility, transportation, or communication systems.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the use of portable devices that use satellite technology would not impact infrastructure resources because there would be no change to the built or natural environment from the use of portable equipment. Installation of satellite-enabled equipment would not be expected to have any impacts to infrastructure resources, given that construction activities would occur on existing structures, would not be expected to interfere with existing equipment, and transportation capacity and safety, and access to emergency services would not be impacted.
    - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN, however it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact infrastructure resources, it is anticipated that this activity would have no impact on infrastructure resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to infrastructure as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of direct interface with existing infrastructure, most notably existing telecommunication infrastructure. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to infrastructure include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to infrastructure resources, depending on the specific assets connected on either end of the buried fiber. If a fiber optic plant is being used to tie into existing telecommunications assets, then localized impacts to telecommunications sites could occur during the deployment phase, however, it is anticipated that this tie-in would cause less than significant impacts as the activity would be temporary and minor.
  - New Build – Aerial Fiber Optic Plant: Installation of a new aerial fiber optic plant could impact new telecommunications infrastructure through the installation of new or replacement of existing telecommunications poles.
  - Collocation on Existing Aerial Fiber Optic Plant: Similar to new build activities (above), collocation on existing aerial fiber optic plant could include installation of new or replacement towers requiring ground disturbance.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment such as small boxes or huts, or access roads could potentially impact infrastructure. Impacts could include disruption of service in transportation corridors, disruption of service to telecommunications infrastructure, or other temporary impacts.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads might result in temporary or unintended impacts to current utility services during installation or interconnection activities. Generally, however, these deployment activities would be independent and would not be expected to interfere with other existing towers and structures. In addition, installation activities would have beneficial impacts due to expansion of infrastructure at a local level. Such activities could enhance public safety infrastructure, and other telecommunications as the site could potentially be available for subsequent collocation.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would result in localized impacts to that tower and such as minor disruptions in services. As a result of collocation of equipment, the potential addition of power units, structural hardening, and physical security measures could potentially have beneficial impacts on existing infrastructure assets, depending on the site specific plans.

- Deployable Technologies: Deployable technologies such as COWs, COLTs, and SOWs are comprised of cellular base stations, sometimes with expandable antenna masts, and generators that may require connection to utility power cables. Connecting the generators to utility power cables has the potential to disrupt electric power utility systems or cause power outages; however this is expected to be temporary and minor. Some staging or landing areas (depending on the type of technology) could require minor construction and maintenance within public road ROWs and utility corridors, heavy equipment movement, and minor excavation and paving near public roads, which have the potential to impact transportation capacity and safety as these activities could increase transportation congestion and delays. Implementation of deployable technologies could result in potential impacts to infrastructure resources in terms of infrastructure expansion, if deployment requires paving of previously unpaved surfaces or other new infrastructure build to accommodate the deployable technology. Also, beneficial impacts could be realized, as deployable technologies are used when other infrastructure is impaired in some way; so deployable technologies could provide continuity of service during emergency events. Where deployable technologies would be implemented on existing paved surfaces and the acceptable load on those paved surfaces is not exceeded, or where aerial deployable technologies may be launched or recovered on existing paved surfaces, it is anticipated that there would be no impacts to infrastructure resources because there would be no disturbance of the natural or built environment.

In general, the abovementioned activities could potentially impact infrastructure resources in different ways, resulting in both potentially negative and potentially positive impacts. Potential negative impacts to infrastructure associated with deployment could include temporary disruption of various types of transportation corridors, temporary impacts on existing or new telecommunications sites, and more permanent 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) and would be regionally based around the on-going phase of deployment, and minor. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Positive impacts to infrastructure resources may result from the expansion of public safety and commercial telecommunications capacity and an improvement in public safety telecommunications coverage, system resiliency, response times, and system redundancy.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in potential impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to infrastructure associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if further construction related activities are required along public road and utility ROWs, increased traffic congestion, current telecommunication system interruption, and utility interruptions could occur. These potential impacts would be expected to be minor and temporary as explained above.

Numerous beneficial impacts would be associated with operation of the NPSBN. The new system is intended to result in substantial improvements in public safety response times and the ability to communicate effectively with and between public safety entities, and would also likely result in substantial improvements in level of service and communications capabilities. Operation of the NPSBN is intended to involve high-speed data capabilities, location information, images, and eventually streaming video, which would likely significantly improve communications and the ability of the public safety community to effectively engage and respond. The NPSBN is also intended to have a higher level of redundancy and resiliency than current commercial networks to support the public safety community effectively, even in events of extreme demand. This improvement in the level of resiliency and redundancy is intended to increase the reliability of systems, communications, and level of service, and also minimize disruptions and misinformation resulting from limited or disrupted service. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.1.5. Alternatives Impact Assessment

The following section assesses potential impacts to infrastructure associated with the Deployable Technologies Alternative and the No Action Alternative.[152]

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.

[152] As mentioned above and in Section 2.1.2, Proposed Action Infrastructure, the Preferred Alternative includes implementation of deployable technologies.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to infrastructure even 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 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.

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 roads or utility ROWs, 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated deployment or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to infrastructure from deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.1, Infrastructure. The state also would not realize positive, beneficial impacts to infrastructure resources described above.

3.2.2. Soils

3.2.2.1. Introduction

This section describes potential impacts to soil resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.2.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on soil resources were evaluated using the significance criteria presented in Table 3.2.2-1. As described in Section 3.1.2, 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 3.2.2-1: Impact Significance Rating Criteria for Soils

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Soil erosion	Magnitude or Intensity	Severe, widespread, and observable erosion in comparison to baseline, high likelihood of encountering erosion-prone soils.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible erosion in comparison to baseline conditions; low likelihood of encountering erosion-prone soil types.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term erosion not likely to be reversed over several years.		Isolated, temporary, or short-term erosion that that is reversed over few months or less.	NA
Topsoil mixing	Magnitude or Intensity	Clear and widespread mixing of the topsoil and subsoil layers.	Effect that is potentially significant, but with mitigation is less than significant.	Minimal mixing of the topsoil and subsoil layers has occurred.	No perceptible evidence that the topsoil and subsoil layers have been mixed.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	NA		NA	NA
Soil compaction and rutting	Magnitude or Intensity	Severe and widespread, observable compaction and rutting in comparison to baseline.	Effect that is potentially significant, but with mitigation is less than significant.	Perceptible compaction and rutting in comparison to baseline conditions.	No perceptible change in baseline conditions.
	Geographic Extent	State or territory.		Region or county.	NA
	Duration or Frequency	Chronic or long-term compaction and rutting not likely to be reversed over several years.		Isolated, temporary, or short term compaction and rutting that is reversed over a few months or less.	No perceptible change in baseline conditions.

NA = Not Applicable

3.2.2.3. Description of Environmental Concerns

Soil Erosion

Soil erosion is an environmental concern of nearly every construction activity that involves ground disturbance. Construction erosion typically only occurs in a small area of land with the actual removal of vegetative cover from construction equipment or by wind and water erosion. Of concern in Colorado 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 Colorado that have steep slopes (i.e., greater than 20 percent) or where the erosion potential is medium to high, including locations with Albolls, Aquents, Aquepts, Aquolls, Argids, Calcids, Cambids, Cryalfs, Cryepts, Cryods, Cryolls, Fluvents, Hemists, Orthents, Salids, Uderts, Ustalfs, Ustepts, Usterts, and Ustolls, which are found throughout the entire state (see Section 3.1.2.6, Soil Erosion and Figure 3.1.2-2).

Based on the impact significance criteria presented in Table 3.2.2-1, building of some of FirstNet's network deployment sites could cause potentially significant erosion at locations with highly erodible soil and steep grades.

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 to avoid or minimize impacts and minimize the periods when exposed soil is open to precipitation and wind (see Chapter 19).

Topsoil Mixing

The loss of topsoil (i.e., organic and mineral topsoil layers) by mixing is a potential impact at all ground disturbing construction sites, including actions requiring clearing, excavation, grading, trenching, backfilling, or site restoration/remediation work.

Based on impact significance criteria presented in Table 3.2.2-1, and due to the relatively small scale (less than 1 acre) of most FirstNet project sites, minimal topsoil mixing is anticipated. Implementation of BMPs and mitigation measures (see Chapter 19) could further reduce potential impacts.

Soil Compaction and Rutting

Soil compaction and rutting at construction sites could involve heavy land clearing equipment such as bulldozers and backhoes, trenchers and directional drill rigs to install buried fiber, and cranes to install towers and aerial infrastructure. Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 3.1.2.3, Soil Suborders). Heavy equipment could cause perceptible compaction and rutting of susceptible soils, particularly if BMPs and mitigation measures are not implemented.

Soils with the highest potential for compaction or rutting were identified by using the STATSGO2 database (see Section 3.1.2.4, Soil Suborders). The most compaction susceptible soils in Colorado are Albolls, Aquents, Aquepts, Aquolls, Hemists, and Ustolls suborders, which are found mostly in alpine environments, western, and northeastern areas of the state (Figure 3.1.2-2). These soils are found in approximately 30 percent of Colorado. The potential for compaction or rutting impact would be generally low at FirstNet network deployment sites where other soil types predominate.

Based on impact significance criteria presented in Table 3.2.2-1, the risk of soil compaction and rutting resulting from First Net deployment activities would be less than significant due to the extent of susceptible soils in the state.

3.2.2.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to soil resources and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to soil resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Installation of fiber optic cable in existing conduit through existing hand-holes, pulling vaults, junction boxes, huts, and POP structures and would not impact soil resources because it would not produce perceptible changes to soil resources.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber would be conducted electronically through existing infrastructure, with no impacts to soil resources. If physical access is required to light dark fiber, it would be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Deployment of temporary or portable equipment that use satellite technology, including COWs, COLTs, SOWs, satellite phones, and video cameras, would not impact soil resources because those activities would not require ground disturbance.

- Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the nationwide public safety broadband network (NPSBN); however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact soil resources, it is anticipated that this activity would have no impact on soil resources.

Activities with the Potential to Have Impacts

Implementation of the Preferred Alternatives could include potential deployment-related impacts to soil resources resulting from ground disturbance activities, including soil erosion, topsoil mixing, and soil compaction and rutting. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to soil resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures that require ground disturbance. Impacts from fiber optic plant installation and structure construction, as well as associated grading and restoration of the disturbed ground when construction is completed, could result in soil erosion, topsoil mixing, or soil compaction and rutting.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and replacement/upgrading of existing poles and structures could potentially impact soil resources resulting from ground disturbance for pole/structure installation (soil erosion and topsoil mixing), and heavy equipment use from bucket trucks operating on existing gravel or dirt roads (soil compaction and rutting). Potential impacts to soils are anticipated to be small-scale and short-term.
  - Collocation on Existing Aerial Fiber Optic Plant: Topsoil removal, soil excavation, and excavated material placement during the replacement of poles and structural hardening could result in soil erosion and topsoil mixing. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in soil compaction and rutting.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of optical transmission equipment or centralized transmission equipment, including associated new utility poles, hand holes, pulling vault, junction box, hut, and POP structure installation, would require ground disturbance that could potentially impact soil resources. Potential impacts to soils resulting from soil erosion, topsoil mixing, soil compaction, and rutting are anticipated to be small-scale and short-term.

- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads could result in impacts to soil resources. Land/vegetation clearing, excavation activities, landscape grading, and other ground disturbance activities during the installation of new wireless towers and associated structures or access roads could result in soil erosion or topsoil mixing, and heavy equipment use during these activities could result in soil compaction and rutting.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to soils. However, if additional power units, structural hardening, and physical security measures are needed they may require ground disturbance, such as grading, or excavation activities, impacts to soil resources could occur, including soil erosion and topsoil mixing, as well as soil compaction and rutting associated with heavy equipment use.
    - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to soil resources depending on the technology and location for deployment. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, 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 ROWs for deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described earlier, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to soil resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, soil compaction and rutting impacts could result as explained above. The impacts are expected to be less than significant due to the temporary nature and small-scale of operations activities with the potential to create impacts. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.2.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to soil resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to soil resources even if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces, due to the small-scale nature of expected FirstNet activities in any particular location. 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to soil resources associated with routine inspections of deployable assets, assuming that the same access roads used for deployment are also used for inspections. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors, or if the acceptable load of the surface is exceeded, less than significant soil compaction and rutting impacts could result as previously explained above. Finally, if deployable technologies are parked and operated with air conditioning for extended periods, the condensation water from the air conditioner could result in minimal soil erosion. However, it is anticipated that the potential soil erosion would result in less than significant impacts as described above. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to soil resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.2, Soils.

3.2.3. Geology

3.2.3.1. Introduction

This section describes potential impacts to Colorado geology resources associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.3.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on geology resources were evaluated using the significance criteria presented in Table 3.2.3-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to geology addressed in this section are presented as a range of possible impacts.

Table 3.2.3-1: Impact Significance Rating Criteria for Geology

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Seismic Hazard	Magnitude or Intensity	High likelihood that a project activity could be located within a high-risk earthquake hazard zone or active fault.	Effect that is 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
Landslide	Magnitude or Intensity	High likelihood that a project activity could be located within a landslide area.	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within a landslide area.	No likelihood of a project activity located within a landslide hazard area.
	Geographic Extent	Landslide areas are highly prevalent within the state/territory.		Landslide areas occur within the state/territory, but may be avoidable.	Landslide hazard areas do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Land Subsidence	Magnitude or Intensity	High likelihood that a project activity could be located within an area with a hazard for subsidence (e.g., karst terrain).	Effect that is potentially significant, but with mitigation is less than significant.	Low likelihood that a project activity could be located within an area with a hazard for subsidence.	Project activity located outside an area with a hazard for subsidence.

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	Areas with a high hazard for subsidence (e.g., karst terrain) are highly prevalent within the state/territory.		Areas with a high hazard for subsidence occur within the state/territory, but may be avoidable.	Areas with a high hazard for subsidence do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA
Potential Mineral and Fossil Fuel Resource Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to mineral and/or fossil fuel resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to mineral and/or fossil resources.	No perceptible change in mineral and/or fossil fuel resources.
	Geographic Extent	Regions of mineral or fossil fuel extraction areas are highly prevalent within the state/territory.		Mineral or fossil fuel extraction areas occur within the state/territory, but may be avoidable.	Mineral or fossil fuel extraction areas do not occur within the state/territory.
	Duration or Frequency	Long-term or permanent degradation or depletion of mineral and fossil fuel resources.		Temporary degradation or depletion of mineral and fossil fuel resources.	NA
Potential Paleontological Resources Impacts	Magnitude or Intensity	Severe, widespread, observable impacts to paleontological resources.	Effect that is potentially significant, but with mitigation is less than significant.	Limited impacts to paleontological and/or fossil resources.	No perceptible change in paleontological resources.
	Geographic Extent	Areas with known paleontological resources are highly prevalent within the state/territory.		Areas with known paleontological resources occur within the state/territory, but may be avoidable.	Areas with known paleontological resources do not occur within the state/territory.
	Duration or Frequency	NA		NA	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Surface Geology, Bedrock, Topography, Physiography, and Geomorphology	Magnitude or Intensity	Substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.	Effect that is potentially significant, but with mitigation is less than significant.	Minor degradation or alteration of surface geology, bedrock, topography that do not result in measurable changes in physiographic characteristics or geomorphological processes.	No degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphologic processes.
	Geographic Extent	State/territory.		State/territory.	NA
	Duration or Frequency	Permanent or long-term changes to characteristics and processes.		Temporary degradation or alteration of resources that is limited to the construction and deployment phase.	NA

NA= Not Applicable

3.2.3.3. Description of Environmental Concerns

Environmental concerns regarding geology can be viewed as two distinct types, those that would potentially provide impacts to the project, such as seismic hazards and landslides, and those that the project would potentially cause, such as land subsidence, mineral and fossil fuel resources, paleontological resources, surface geology, bedrock, topography, physiography, and geomorphology. These concerns and their impacts on geology are discussed below.

Seismic Hazard

A concern related to deployment is placement of equipment in highly active seismic zones. Equipment that is exposed to earthquake activity is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss. As discussed in Section 3.1.3.8, Colorado has experienced six earthquakes of a magnitude 5.0 (on the Richter scale) or greater between 1960 and 2011. As shown in Figure 3.1.3-6, central Colorado and areas in the northwest are at greatest risk to earthquakes throughout the state, though no earthquake over magnitude 6.0 on the Richter scale has ever occurred in the state. Based on the impact significance criteria presented in Table 3.2.3-1, seismic impacts would be less than significant even if FirstNet's deployment locations were within high-risk earthquake hazard zones or active fault zones, to the small scale and short-term nature of the deployment. Given the potential for minor earthquakes in or near Colorado, some amount of infrastructure could be subject to earthquake hazards, in which case BMPs and mitigation measures (see Chapter 19) could help avoid or minimize the potential impacts.

Volcanic Activity

Volcanoes were considered but not analyzed for Colorado. The Dotsero Volcanic Center in central Colorado was active between 3,800 and 5,500 years ago (USGS, 2015c); therefore, volcanoes do not present a hazard to the state.

Landslides

Similar to seismic hazards, another concern would be placement of equipment in areas that are highly susceptible to landslides. Equipment that is exposed to landslides is subject to misalignment, alteration, or, in extreme cases, destruction; all of these activities could result in connectivity loss.

As discussed in Section 3.1.3.8, the majority of Colorado is at moderate to low risk of experiencing landslide events. Based on the impact significance criteria presented in Table 3.2.3-1, potential impacts associated with landslides from deployment or operation of the Proposed Action would have less than significant impacts as it is likely that the project would attempt to avoid areas that are prone to landslides; however, landslide impacts to the Proposed Action could be potentially significant if FirstNet’s deployment locations were within areas in which landslides are highly prevalent. Where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in see Chapter 19, could help avoid or minimize the potential impacts.

Land Subsidence

As discussed in Section 3.1.3.8 and shown in Figure 3.1.3-8, portions of Colorado are vulnerable to land subsidence due to karst topography and mine collapse. Based on the impact significance criteria presented in Table 3.2.3-1, potential impacts to soil subsidence from deployment or operation of the Proposed Action would have less than significant impacts; however, subsidence impacts to the Proposed Action could be potentially significant if FirstNet's deployment locations were within areas at high risk to karst topography or located in mining areas. Equipment that is exposed to land subsidence, such as sinkholes created by karst topography is subject to misalignment, alteration, or, in extreme cases, destruction. All of these activities could result in connectivity loss. To the extent practicable, FirstNet would avoid deployment in known areas of karst topography or where mine collapse is possible. However, where infrastructure is subject to landslide hazards, BMPs and mitigation measures, as discussed in Chapter 19, could help avoid or minimize the potential impacts.

Potential Mineral and Fossil Fuel Resource Impacts

Equipment deployment near mineral and fossil fuel resources are not likely to affect these resources. Rather the new construction is only likely to limit access to extraction of these resources. Based on the impact significance criteria presented in Table 3.2.3-1, 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.

Potential Paleontological Resource Impacts

Equipment installation and construction activities that require ground disturbance could damage existing paleontological resources, which are both fragile and irreplaceable. Based on the impact significance criteria presented in Table 3.2.3-1, impacts to paleontological resources could be potentially significant if FirstNet's buildout/deployment locations uncovered paleontological resources during construction activities. As discussed in Section 3.1.3.6., fossil-bearing formations of note in Colorado include the White River, Green River, and Morrison formations. 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 fossil resources should be considered on a site-by-site basis, and BMPs and mitigation measures (see Chapter 19) could further help avoid or minimize the 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 3.2.3-1, impacts could be potentially significant if FirstNet's deployment were to cause substantial and measurable degradation or alteration of surface geology, bedrock, topography, physiographic characteristics, or geomorphological processes.

Construction activities related to the Proposed Action and Alternatives are likely to be minor and less than significant as the proposed activities are not likely to require removal of significant volumes of terrain and any rock ripping would likely occur in discrete locations and would be unlikely to result in large-scale changes to the geologic, topographic, or physiographic characteristics. When ground disturbance is required, BMPs and mitigation measures (see Chapter 19) could be implemented to help avoid or minimize the potential impacts.

3.2.3.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

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 to 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 POP huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to geologic resources due to associated ground disturbance, such as impacts to fuel and mineral resources or paleontological resources. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Aerial Fiber Optic Plant: Installation of new utility poles, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - Collocation on Existing Aerial Fiber Optic Plant: Replacement of utility poles and structural hardening, and associated use of heavy equipment during construction, could result in potential impacts to geologic resources due to associated ground disturbance. Where equipment is installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that equipment could be affected by that hazard.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: 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, or the use of portable devices that use satellite technology would not impact geologic resources because those activities would not require ground disturbance. However, where equipment is permanently installed in locations that are susceptible to landslides, earthquakes, and other geologic hazards, it is possible that they could be affected by that hazard. The use of portable satellite-enabled devices would not impact geologic resources nor would it be affected by geologic hazards because there would be no ground disturbance nor any impact to the built or natural environment.

In general, the abovementioned activities could potentially involve ground disturbance resulting from land/vegetation clearing, topsoil removal, excavation, excavated material placement, trenching or directional boring, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to geological resources associated with deployment could include minimal removal of bedrock or mineral resources, or adverse impacts to installed equipment resulting from geologic hazards (e.g., seismic hazards, landslides, and land subsidence). Specific FirstNet projects are likely to be small scale; correspondingly, disturbance to geologic resources for those types of projects with the potential to impact geologic resources is also expected to be small scale as a result, these potential impacts are expected to be less than significant due to the small scale and short-term nature of the deployment. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to geological resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections.

The operation of the Preferred Alternative could be affected by geologic hazards including seismic 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 19 discusses BMPs and mitigation measures that could be implemented, as appropriate, to avoid or minimize potential impacts.

3.2.3.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to geology as a result of implementation of this alternative could be as described below.

Deployment Impacts

Implementation of deployable technologies on existing paved surfaces would not result in impacts to geologic resources (or from geologic hazards) as there would be no ground disturbance and mobile technologies could be moved to avoid geologic hazards. Potential impacts may result if deployment of vehicles (i.e., SOWs, COWs, COLTs) 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 19 discusses BMPs and mitigation measures that could be implemented, as appropriate, 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.

The operation of the Deployable Technologies Alternative could be affected by to geologic hazards including seismic 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 are subject to increased seismic activity, landslides, and land subsidence. Chapter 19 discusses BMPs and mitigation measures that could be implemented, as appropriate, 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) from deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.3, Geology.

3.2.4. Water Resources

3.2.4.1. Introduction

This section describes potential impacts to water resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19 discusses BMPs and mitigation measures that could be implemented, as appropriate, to avoid or minimize potential impacts.

3.2.4.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on water resources were evaluated using the significance criteria presented in Table 3.2.4-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to water resources addressed in this section are presented as a range of possible impacts.

Table 3.2.4-1: Impact Significance Rating Criteria for Water Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Water Quality (groundwater and surface water) - sedimentation, pollutants, nutrients, water temperature	Magnitude or Intensity	Groundwater contamination creating a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer; local construction sediment water quality violation, or otherwise substantially degrade water quality; water degradation poses a threat to the human environment, biodiversity, or ecological integrity. Violation of various regulations including: CWA, SDWA.	Effect that is potentially significant, but with mitigation is less than significant.	Potential impacts to water quality, but potential effects to water quality would be below regulatory limits and would naturally balance back to baseline conditions.	No changes to water quality; no change in sedimentation or water temperature, or the presence of water pollutants or nutrients.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Impact is temporary, lasting no more than six months.	NA
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).

NA = Not Applicable

3.2.4.3. Description of Environmental Concerns

Potential Water Quality Impacts

Water quality impaired waterbodies are those waters that have been identified as not supporting their appropriate uses. Projects in watersheds of impaired waters may be subject to heightened permitting requirements. For example, the CWA requires states to assess and report on the quality of waters in their state. Section 303(d) of the CWA requires states to identify impaired waters. For these impaired waters, states must consider the development of a Total Maximum Daily Load (TMDL) or other strategy to reduce the input of the specific pollutant(s) restricting waterbody uses, in order to restore and protect such uses.

Most of Colorado's rivers and streams are in good condition, close to half of Colorado's lakes, reservoirs, and ponds that were assessed are impaired (see Table 3.1.4-2, Figure 3.1.4-3). The most common pollutants associated with impaired waters in Colorado are heavy metals (copper, lead, mercury, selenium, and zinc) and other metals including iron. Arsenic is also a common pollutant, as are radionuclides, including uranium. Lake impairments are typically associated with dissolved oxygen and mercury, and occur across the state. Groundwater quality within the state is generally good. (USEPA, 2016j)

Deployment activities could contribute to water quality impacts in a number of ways. Vegetation removal on site exposes soils to rain and wind that could increase erosion. Impacts to water quality may occur from post construction vegetation management, such as herbicides, that may leach into groundwater or move to surface waters through soil erosion or runoff, spray drift, or inadvertent direct overspray. Fuel, oil, and other lubricants from equipment could contaminate groundwater and surface waters if carried in runoff. Other water quality impacts could include changes in temperature, pH or dissolved oxygen levels, water odor, color, or taste, or addition of suspended solids.

Soil erosion or the introduction of suspended solids into waterways from implementation of the Preferred Alternative could contribute to degradation of water quality. If the Proposed Action and Alternatives would disturb more than 1 acre of soil, a state or USEPA NPDES Construction General Permit (CGP) would be required. As part of the permit application for the CGP, a stormwater pollution prevention plan (SWPPP) would need to be prepared containing BMPs that would be implemented to prevent, or minimize the potential for, sedimentation and erosion. Adherence to the CGP and the BMPs would help prevent sediment and suspended solids from entering the waterways and ensure that effects on water quality during construction would not be adverse.

Deployment activities associated with the Proposed Action have the potential to increase erosion and sedimentation around construction and staging areas. Grading activities associated with construction would potentially result in a temporary increase in the amount of suspended solids running off construction sites. If a storm event were to occur, construction site runoff could result in sheet erosion of exposed soil. If not adequately controlled, water runoff from these areas would have the potential to degrade surface water quality. Implementing BMPs and mitigation measures could help reduce potential impacts to surface water quality.

Expected deployment activities would not violate applicable state, federal (e.g., CWA, and Safe Drinking Water Act), or local regulations, cause a threat to the human environment, biodiversity, or ecological integrity through water degradation, or cause a sediment water quality violation from local construction, or otherwise substantially degrade water quality.

Therefore, based on the impact significance criteria presented in Table 3.2.4-1, water quality impacts would likely be less than significant, and could be further reduced if BMPs and mitigation measures were to be incorporated where practicable and feasible.

During implementation of the Proposed Action and Alternatives, there is the potential to encounter shallow groundwater due to clearing and grading activities, shallow excavation, or relocation of utility lines. This is unlikely, as trenching is not expected to exceed a 48-inch depth. However, groundwater contamination may exist in areas directly within or near the project area. If trenching[153] 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 or as required by a dewatering permit may need to be treated prior to discharge or disposed of at a wastewater treatment facility.

Construction activities would need to comply with Colorado dewatering requirements. Due to average thickness of most Colorado aquifers, there is a low potential for groundwater contamination within a watershed or multiple watersheds. Thus, it is unlikely that the majority of FirstNet's deployment locations would result in a drinking quality violation, or otherwise substantially degrade groundwater quality or aquifer, and based on the impact significance criteria presented in Table 3.2.4-1, there would likely be less than significant impacts on groundwater quality within most of the state. In areas where groundwater is close to the surface, then site-specific analysis, BMPs, and mitigation measures could be implemented to further reduce potential impacts.

Floodplain Degradation

Floodplains are low-lying lands next to rivers and streams. When left in a natural state, floodplain systems store and dissipate floods without adverse impacts on humans, buildings, roads and other infrastructure. The 500-year floodplain is the area of minimal flood hazard, where there is a 0.2-percent-annual-chance flood. Some projects may be outside of a floodplain, but still be in an area with known flooding history.

Based on the impact significance criteria presented in Table 3.2.4-1, floodplain degradation impacts would be potentially less than significant since the majority of FirstNet's likely deployment activities, on the watershed or subwatershed level, would occur inside the 500-year floodplain, 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

[153] 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).

deployed in response to an emergency. Additionally, any effects would be temporary, lasting no more than one season or water year,[154] 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 19).

Drainage Pattern Alteration

Flooding and erosion from land disturbance could changes drainage patterns. Stormwater runoff causes erosion while construction activities and land clearing could change drainage patterns. Clearing or grading activities, or the creation of walls or berms, could alter water flow in an area or cause changes to drainage patterns. Drainage could be directed to stormwater drains, storage, and retention areas designed to slow water and allow sediments to settle out. Improperly handled drainage could cause increased erosion, changes in stormwater runoff, flooding, and damage to water quality. Existing drainage patterns could be modified by channeling (straightening or restructuring natural watercourses); creation of impoundments (detention basins, retention basins, and dams); stormwater increases; or altered flow patterns.

According to the significance criteria in Table 3.2.4-1, any temporary (lasting less than six months) alterations to drainage patterns that are minor and mimic natural processes or variations within the watershed or subwatershed level would be considered less than significant.

Example of projects that could have minor changes to the drainage patterns include:

- Land uses with pervious surfaces that create limited stormwater runoff.
- Activities designed so that stormwater is contained on site and does not flow to or impact surface waterbodies offsite on other properties.
- Activities designed so that the amount of stormwater generated before construction is the same as afterwards.
- Activities designed using low impact development techniques for stormwater.

Since the proposed activities would not substantially alter drainage patterns in ways that alter the course of a stream or river; create a substantial and measurable increase in the rate and amount of surface water; or change the hydrologic regime; and any effects would be short-term; impacts to drainage patterns would be less than significant. BMPs and mitigation measures could be implemented to further reduce any potentially significant impacts.

[154] A water year is defined as “the 12-month period October 1, for any given year through September 30, of the following year. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months.” (USGS, 2016f)

Flow Alteration

Flow alteration refers to the modification of flow characteristics, relative to natural conditions. Human activities may change the amount of water reaching a stream, divert flow through artificial channels, or alter the shape and location of streams. Surface water and groundwater withdrawals could alter flow by reducing water volumes in streams. Withdrawals may return to the surface/groundwater system at a point further downstream, be removed from the watershed through transpiration by crops, lawns or pastures, or be transferred to another watershed altogether (e.g., water transferred to a different watershed for drinking supply). Altered flow could increase flooding and introduce more erosion and potential for pollution. Alternatively, if water is diverted from its normal flow, the opposite may occur; wetlands and streams may not receive as much water as necessary to maintain the ecology and previous functions.

Activities that do not impact discharge or stage of waterbody (stream height) are not anticipated to have an impact on flow, according to Table 3.2.4-1. Projects that include minor consumptive use of surface water with less than significant impacts on discharge (do not direct large volumes of water into different locations) on a temporary (no more than six months) are likely to have less than significant impacts on flow alteration, on a watershed or subwatershed level. Examples of projects likely to have less than significant impacts include:

- Construction of any structure in a 100-year or 500-year floodplain that is built above base flood elevation pursuant to floodplain management regulations.
- Land uses that are maintaining or increasing pervious surfaces.
- Land uses that do not change the flow of water or drainage patterns off site or into surface water bodies that have not received that volume of stormwater previously.
- Minor clearing or grading activities.

Since the proposed activities would not likely alter flow characteristics or change the hydrologic regime, impacts would be less than significant impacts to flow alteration. BMPs and mitigation measures could be implemented to further reduce any impacts.

Changes in Groundwater or Aquifer Characteristics

As described in Section 3.1.4.7, surface water provides the majority of the state’s water supply, with only approximately 2 percent of Colorado residents using groundwater for public water supply needs. Approximately 96 percent of groundwater in Colorado is used for irrigation. Colorado’s aquifers are used mostly for agricultural uses. Water supply demand from the deployment activities is unlikely to exceed safe and sustainable withdrawal capacity rate of the local supply or aquifer.

Storage of generator fuel over groundwater or an aquifer would unlikely cause any impacts to water quality. Activities that may cause changes is groundwater or aquifer characteristics include:

- Excavation, mining, or dredging during or after construction.
- Any liquid waste, including but not limited to wastewater, generation.
- Storage of petroleum or chemical products.

- Private and public water supplies often use groundwater as a water source. To maintain a sustainable system, the amount of water withdrawn from these groundwater sources must be balanced with the amount of water returned to the groundwater source (groundwater recharge).

Deployment activities will likely have less than significant impacts since they would not substantially deplete supplies of potable groundwater, as any construction dewatering would be short-term. The siting of deployment activities should, as practicable and feasible, be considered to avoid areas that would extract groundwater from potable groundwater sources in the area.

3.2.4.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, 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 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.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Infrastructure, the following are likely to have no impacts to water resources 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 to 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 or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - 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 could potentially impact water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location.

Trenching would not be expected to occur near or below the existing water table (depth to water). If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to water resources.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security lighting, electrical feeds, and concrete foundations and pads) or access roads could result in potential direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites. The amount of impact depends on the land area affected, installation technique, and location. Trenching would not be expected to occur near or below the existing water table (depth to water). Implementing BMPs could reduce impact intensity. If a new roadway were built, additional impervious surface would not be expected to impact water resources or the overall amount of runoff and nonpoint pollution.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to water resources. However, if the onsite delivery of additional power units, structural hardening, and physical security measures required ground disturbance, impacts to water resources could occur, including increased suspended solids leading to impaired water quality and impacts to groundwater from excavation.
  - Deployable Technologies: Implementation of land-based deployable technologies could result in potential impacts to water resources if deployment involves movement of equipment through streams, occurs in riparian or floodplain areas, occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and indirect impacts to water quality from a temporary increase in the amount of suspended solids running off construction sites or deployment in unpaved areas. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in indirect impacts on water quality if fuels leak into surface or groundwater. Where deployable technologies would be implemented on existing paved surfaces, or where aerial and vehicular deployable technologies may be used on existing paved surfaces, it is anticipated that there would be no impacts to water resources because there would be no ground disturbance.

    Deployment of drones, balloons, blimps, 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to water resources associated with deployment of this infrastructure would likely be less than significant due to the limited geographic scale of individual activities and would likely return to baseline conditions once revegetation of disturbed areas is complete. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities, and are expected to have no impacts as there would be no ground disturbing activity and it is likely routine maintenance activities would be conducted along exiting roads and utility ROWs. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. Impacts to surface and groundwater quality from routine operations and maintenance, such as herbicide application to control vegetation, are not expected. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.4.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to water resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to water resources if the deployment 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 use 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The water resources impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the water resource's current use (sole source for drinking water, considered exceptional value for recreation, or provides critical habitat for a species).

It is anticipated that there would be less than significant impacts to water resources associated with routine inspections of the Deployable Technologies Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off of established access roads or corridors and near waterbodies, the resulting ground disturbance could increase sedimentation in waterbodies, potentially impacting water quality. It is assumed that routine maintenance would not include operation of vehicles or equipment in waterbodies. Finally, if ground-based deployable technologies are parked and operated with air conditioning for extended periods of time, the condensation water from the air conditioner could result in soil erosion that could potentially impact waterbodies if the deployables are located adjacent to waterbodies, however, due to the limited and temporary nature of the deployable activities, it is anticipated that these potential impacts would be less than significant. 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to water resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.4, Water Resources.

3.2.5. Wetlands

3.2.5.1. Introduction

This section describes potential impacts to wetlands in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19 identifies BMPs and mitigation measures that could be implemented, as appropriate, to avoid or minimize potential impacts.

3.2.5.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on wetlands were evaluated using the significance criteria presented in Table 3.2.5-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to wetlands addressed in this section are presented as a range of possible impacts.

Table 3.2.5-1: Impact Significance Rating Criteria for Wetlands

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Direct wetland loss (fill or conversion to non-wetland)	Magnitude[a] or Intensity	Substantial loss of high-quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.); violations of Section 404 of the CWA.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity).	No direct loss of wetlands.
	Geographic Extent/Context	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	Duration or Frequency	Chronic and long term changes not likely to be reversed over several years or seasons.		Periodic and/or temporary loss reversed over 1-2 growing seasons with or without active restoration.	NA
Other direct effects: vegetation clearing; ground disturbance; direct hydrologic changes (flooding or draining); direct soil changes; water quality degradation (spills or sedimentation)	Magnitude or Intensity	Substantial and measurable changes to hydrological regime of the wetland impacting salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	Effect that is potentially significant, but with mitigation is less than significant.	Impacts to lower quality wetlands affecting the hydrological regime including salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality; introduction and establishment of invasive species to high quality wetlands.	No direct impacts to wetlands affecting vegetation, hydrology, soils, or water quality.
	Geographic Extent	Watershed level, and/or within multiple watersheds.		Watershed or subwatershed level.	NA
	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	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
				seasons with or without active restoration.	
Indirect effects[b]: change in function(s)[c] change in wetland type	Magnitude or Intensity	Changes to the functions or type of high quality wetlands (e.g., those that provide critical habitat for sensitive or listed species, are rare or a high-quality example of a wetland type, are not fragmented, support a wide variety of species, etc.).	Effect that is potentially significant, but with mitigation is less than significant.	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

3.2.5.3. Description of Environmental Concerns

Potential Direct Wetland Loss (Fill or Conversion to Non-Wetland)

Construction-related impacts from several of the deployment activities have the potential for direct wetland impacts such as filling, draining, or conversion to a non-wetland. Examples include placement of fill in a wetland to construct a new tower, trenching through a wetland or directly connected waterway to install a cable, and placement of a structure (tower, building) within the wetland.

Wetlands regulate the quality and quantity of surface and groundwater supplies, reduce flood hazards by serving as retention basins for surface runoff, and maintain water supplies after floodwaters subside. If wetlands were filled, the entire area may be at risk for increased flooding. There could be a loss of open space to be enjoyed by the community, and decreased wildlife populations may be observed due to displacement and increased noise, light, and other human disturbance. To the extent practicable or feasible, FirstNet and/or their partners would avoid filling wetlands or altering the hydrologic regime so that wetlands would not be lost or converted to non-wetlands. Loss of high and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities. Additionally, all site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

The main type of wetlands in Colorado is palustrine (freshwater) wetlands. There are more than 1 million acres of palustrine wetlands throughout Colorado (USEPA 2015a), as shown in Figure 3.1.5-2.

Based on the impact significance criteria presented in Table 3.2.5-1, the deployment activities would most likely have less than significant direct impacts on wetlands. Additionally, the deployment activities would be unlikely to violate applicable federal, state, and local regulations. In Colorado, as discussed in Section 3.1.5.4, Wetlands, there are no regulated high quality wetlands.

In Colorado, as discussed in Wetlands, Section 3.1.5.4, regulated wetlands of special concern or value include fens and wetlands associated with critical resource waters. Fens are found in Colorado's mountainous areas, and are common between elevations of 8,000 and 12,000 feet, particularly in areas where groundwater is at the surface. Although fens are common in the state, they are extremely fragile and if destroyed, cannot be replaced in our lifetime (Culver and Lemly 2013) (CNHP 2012).

Wetlands that are tributaries to, or adjacent to, Colorado's Critical Resource Waters require additional permitting or notification under the state’s regional conditions to the USACE NWP permit. These waters include: The Animas, North Platte, Roaring Fork, Cache la Poudre, Florida, Big Thompson, Blue, Colorado, Dolores, Eagle, Gunnison, Laramie, North Platte, Roaring Fork, Los Pinos, North Fork Gunnison, Piedra, Rio Grande, San Juan, San Miguel, South Platter, Uncompahgre, White, and Yampa Rivers, and Bear, Clear, Sand, Medano, Northwater, Trapper, Abrams, Battlement, Rapid, Boulder, and St. Vrain Creeks, and Smith Fork Rivers. (USACE, 2015)

If any of the proposed deployment activities were to occur in these wetlands of special concern or value, potentially significant impacts could occur. Wetlands occur throughout the state, and are not always included on state maps; therefore, site-specific analysis would be helpful in identifying those locations. Implementation of BMPs and mitigation measures could help to reduce impacts to wetlands.

Potential Other Direct Effects

Direct impacts consist of altering the chemical, physical, or biological components of a wetland to the extent that changes to the wetland functions occur. However, direct impacts would not result in a loss of total wetland acreage. Changes, for example, could include conversion of a forested wetland system to a non-forested state through mechanical or hydrologic manipulation; altered hydrologic conditions (increases or decreases) such as stormwater discharges or water withdrawals that alter the functions of the wetlands.

Based on the impact significance criteria presented in Table 3.2.5-1, construction-related deployment activities that result in long-term or permanent, substantial, and measurable changes to hydrological regime of the wetland (i.e., changes in salinity, pollutants, nutrients, biodiversity, ecological integrity, or water quality) could cause potentially significant impacts. In addition, introduction and establishment of invasive species to wetlands of special concern or value within a watershed or multiple watersheds could be potentially significant. Other direct effects to high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of activities that could have other direct effects to wetlands in Colorado include:

- *Vegetation Clearing:* removing existing vegetation by clearing forest and herbaceous vegetation during construction activities, grading, seeding, and mulching. Clearing and grading may include increased soil erosion and a decrease in the available habitat for wildlife.
- *Ground Disturbance:* Increased amounts of stormwater runoff in wetlands could alter water level response times, depths, and duration of water detention. Reduction of watershed infiltration capacity could cause wetland water depths to rise more rapidly following storm events.
- *Direct Hydrologic Changes (flooding or draining):* Greater frequency and duration of flooding could destroy native plant communities, as could depriving them of their water supply. Hydrologic changes could make a wetland more vulnerable to pollution. Increased water depths or flooding frequency could distribute pollutants more widely through a

wetland. Sediment retention in wetlands is directly related to flow characteristics, including degree and pattern of channelization, flow velocities, and storm surges.
- *Direct Soil Changes:* Changes in soil chemistry could lead to degradation of wetlands that have a specific pH range and/or other parameters.
- *Water Quality Degradation (spills or sedimentation):* The loss of wetlands results in a depletion of water quality both in the wetland and downstream. Filtering of pollutants by wetlands is an important function and benefit. High levels of suspended solids (sedimentation) could reduce light penetration, dissolved oxygen, and overall wetland productivity. Toxic materials in runoff could interfere with the biological processes of wetland plants, resulting in impaired growth, mortality, and changes in plant communities.

Indirect Effects:[155] Change in Function(s)[156] or Change in Wetland Type

Indirect effects to wetlands could include change in wetland function or conversion of a resource to another type (i.e., wetland to an open body of water). The construction of curb and gutter systems diverts surface runoff and could cause flooding or wetlands to dry out, depending on the direction of diversion. Indirect effects to both high- and low-quality wetlands would be less than significant given the amount of land disturbance associated with the project locations (generally less than an acre) and the short time-frame of deployment activities and the application of federal, state, and local wetlands regulations. Additionally, site-specific locations will be subject to an environmental review to help ensure environmental concerns are addressed. Potential wetlands impacts could be further reduced by implementing BMPs and mitigation measures (see Chapter 19).

Examples of functions related to wetlands in Colorado that could potentially be impacted from construction-related deployment activities include:

- *Flood Attenuation*: Wetlands provide flood protection by holding excess runoff after storms, before slowly releasing it to surface waters. While wetlands may not prevent flooding, they could lower flood peaks by providing detention of storm flows. Correspondingly, disturbance of the wetlands (e.g., dredging or filling) could proportionately reduce water storage function.
- *Bank Stabilization*: By reducing the velocity and volume of flow, wetlands provide erosion control, floodwater retention, and reduce stream sedimentation.
- *Water Quality:* Water quality impacts on wetland soils could eventually threaten a wetland's existence. Where sediment inputs exceed rates of sediment export and soil consolidation, a wetland would gradually become filled.
- *Nutrient Processing:* Wetland forests retain ammonia during seasonal flooding. Wetlands absorb metals in the soils and by plant uptake via the roots. They also allow metabolism of

[155] Indirect effects are those resulting from direct effects, but they occur elsewhere in space and/or time. Includes indirect hydrologic effects (wetting or drying) that in turn alters wetland function or type

[156] Wetland functions include hydrologic, ecological, geomorphic, and social functions typically assessed for wetlands as part of USACE compensatory mitigation planning. Typical functions assessed may include flood attenuation, bank stabilization, water quality, organic matter input/transport, nutrient processing, wildlife habitat, T/E species habitat, biodiversity, recreational/social value.

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 3.2.5-1, impacts to lower quality wetlands (e.g., not rare or unique, that have low productivity and species diversity, and those that are already impaired or impacted by human activity), would be considered potentially less than significant. Since the majority of wetlands in Colorado are not considered wetlands of special concern or value, deployment activities would likely have less than significant indirect impacts on wetlands in the state. BMPs and mitigation measures could be implemented, as feasible and practicable, to reduce potential impacts to all wetlands.

FirstNet would likely attempt to avoid areas of the state containing wetlands of special concern or value. If avoidance were not possible, BMPs and mitigation measures could help to mitigate impacts.

3.2.5.4. Potential Impacts of the Preferred Alternative

The following section assesses potential impacts associated with implementation of the Preferred Alternative, including deployment and operation activities. To determine the magnitude of potential impacts of site-specific activities, wetland delineations could be required by a regulatory agency to determine the exact location of all wetlands, including wetlands of special concern or value, 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 to wetlands because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, and the use of portable devices that use satellite technology is not likely to impact wetlands since there would be no ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wetlands, it is anticipated that this activity would have no impact 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., special concern or value). Any ground disturbance could cause direct and/or indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. Implementing BMPs and mitigation measures could reduce impact intensity.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of

water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.

- New Build – Aerial Fiber Optic Plant: Potential impacts would be similar to Buried Fiber Optic Plant. Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected.
- Collocation on Existing Aerial Fiber Optic Plant: Any ground disturbance could cause direct and indirect impacts to wetlands from increased suspended solids and runoff from activities, depending on the proximity to wetlands and type of wetlands that could be affected.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading or other ground disturbance to install small boxes or hunts, or access roads, there could potentially be direct and indirect impacts to wetlands. The amount of impact from a temporary increase in the amount of suspended solids running off construction sites and into wetlands depends on the land area affected, installation technique, and location. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could potentially cause direct and indirect impacts to wetlands. The activities could cause a temporary increase in the amount of suspended solids running off construction sites and into wetlands, depending on their proximity. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type. If trenching were to occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures could reduce impact intensity.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, which would not result in impacts to wetlands. However, if additional power units, structural hardening, and physical security measures required ground disturbance, such as grading, or excavation activities, impacts to wetlands could occur near wetlands, it could cause impacts on wetlands. Implementing BMPs and mitigation measures (see Chapter 19) could reduce impact intensity.
  - Deployable Technologies: Implementation of deployable technologies could result in potential impacts to wetlands if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. The amount of impact depends on the land area affected, installation technique, and location. Implementing BMPs and mitigation measures could reduce impact intensity. The activities could also result in other direct impacts on wetlands if fuels leak into nearby waterbodies or wetlands. Deployment of

drones, balloons, or blimps piloted aircraft could have other direct impacts on wetlands if fuels spill or other chemicals seep into nearby waterbodies or wetlands.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Depending on the deployment activity for this infrastructure, potential impacts to wetlands may occur. The amount of impact depends on the land area affected, installation technique, proximity to wetlands, and type of wetland that could be affected (e.g., special concern or value). Any ground disturbance could cause direct and indirect impacts wetlands, depending on the proximity to wetlands and type of wetlands that could be affected. These impacts are expected to be less than significant due to the small about of land disturbance (generally less than one acre) and the short timeframe of deployment activities. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there could be ongoing other potential 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 ROWs. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.5.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wetlands as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to wetlands. Some staging or launching/landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct and/or indirect impacts to wetlands from a temporary increase in the amount of suspended solids running off construction sites to nearby surface waters. The amount of impact depends on the land area affected, installation technique, and proximity to wetlands, and wetland type; however, impacts are expected to be less than significant due to the small scale and temporary duration of expected FirstNet deployment activities in any one location. To minimize any potential impacts to wetlands, BMPs and mitigation measures would be implemented in compliance with any issued federal, state, and local permits. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Deployable Technologies Alternative would consist of routine maintenance and inspection of the deployable technologies. Any major infrastructure replacement as part of ongoing system maintenance could result in impacts similar to the abovementioned deployment impacts. The wetlands impacts would depend on the watershed, duration (chronic or short-term) and frequency (many years or a few months) the resource would be used, and the wetland's quality and function.

It is anticipated that there would be less than significant impacts to wetlands associated with routine inspections of the Deployable Technologies Alternative, as it is likely existing roads and utility ROWs 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wetlands from deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.5, Wetlands.

3.2.6. Biological Resources

3.2.6.1. Introduction

This section describes potential impacts to terrestrial vegetation, wildlife, fisheries and aquatic habitat, and threatened and endangered species in Colorado associated with deployment and operation of the Proposed Action and its Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.6.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on terrestrial vegetation, wildlife, fisheries, and aquatic habitats were evaluated using the significance criteria presented in Table 3.2.6-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to terrestrial vegetation, wildlife, and fisheries and aquatic habitat addressed in Sections 3.2.6.3, 3.2.6.4, and 3.2.6.5, respectively, are presented as a range of possible impacts.

Refer to Section 3.2.6.6 for impact assessment methodology and significance criterial associated with threatened and endangered species in Colorado.

Table 3.2.6-1: 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), Migratory Bird Treaty Act (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 Colorado for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources, or direct injury or mortality of endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA

Type of Effect	Effect 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 Colorado 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 Colorado 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 Colorado for at least one species. Anthropogenic disturbances that lead to exclusion from nutritional or habitat resources during migration, or lead to changes of migratory routes for endemics or a significant portion of the population or sub-population located in a small area during a specific season.		Effects realized at one location when population is widely distributed, and not concentrated in affected area.	NA
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several years for at least one species.		Temporary, isolated, or short-term effects that are reversed within one to three years.	NA
Reproductive Effects	Magnitude or Intensity	Population or sub-population level effects in reproduction and productivity over several breeding/spawning seasons for at least one species depending on the distribution and the management of said species. Violation of various regulations including: MMPA, MSFCMA, MBTA, and BGEPA.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Effects to productivity are at the individual rather than population level. Effects are within annual variances and not sufficient to affect population or sub-population survival.	No reduced breeding or spawning success.
	Geographic Extent	Regional effects observed within Colorado for at least one species. Anthropogenic disturbances that lead to exclusion from prey or habitat resources required for breeding/spawning or stress, abandonment and loss of productivity for endemics or a		Effects realized at one location.	NA

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
		significant portion of the population or sub-population located in a small area during the breeding/spawning season.			
	Duration or Frequency	Chronic and long-term effects not likely to be reversed over several breeding/spawning seasons for at least one species.		Temporary, isolated, or short-term effects that are reversed within one breeding season.	NA
Invasive Species Effects	Magnitude or Intensity	Extensive increase in invasive species populations over several seasons.	Effect that is potentially significant, but with BMPs and mitigation measures is less than significant.	Mortality observed in individual native species with no measurable increase in invasive species populations.	No loss of forage and cover due to the invasion of exotic or invasive plants introduced to project sites from machinery or human activity.
	Geographic Extent	Regional impacts observed throughout Colorado.		Effects realized at one location.	NA
	Duration or Frequency	Chronic and long-term changes not likely to be reversed over several years or seasons.		Periodic, temporary, or short-term changes that are reversed over one or two seasons.	NA

NA = Not Applicable

3.2.6.3. Terrestrial Vegetation

Impacts to terrestrial vegetation occurring in Colorado are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are permanent or temporary loss or disturbance of individual plants. Based on the impact significance criteria presented in Table 3.2.6-1, direct injury or mortality impacts could be significant if population-level or sub-population effects were observed for at least one species depending on the distribution and the management of the subject species. Direct mortality/injury to plants could occur in construction zones from land clearing, excavation activities, or vehicle traffic; however, these events are expected to be relatively small in scale. The implementation of BMPs and mitigation measures and avoidance measures would help to minimize or altogether avoid potential impacts to plant population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the loss or breaking down of continuous and connected habitat. Areas near urban areas such as Boulder, Denver, and Colorado Springs have experienced extensive land use changes. However, a large portion of the state is mountainous and forested, particularly in the central areas of the state.

Construction of new infrastructure and long-term facility maintenance would result in the alteration of the type of vegetative communities in these localized areas, and in some instances the permanent loss of vegetation. Further, some limited amount of infrastructure may be built in sensitive or rare regional vegetative communities, in which case BMPs and mitigation measures could be implemented to help minimize or avoid potential impacts.

Indirect Injury/Mortality

Indirect effects are effects that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8[b]). Indirect injury/mortality could include stress related to disturbance. The alteration of soils or hydrology within a localized area could result in stress or mortality of plants. Construction activities that remove large quantities of soil in the immediate vicinity of trees could cause undue stress to trees from root exposure, although this is unlikely to occur due to the small size of expected FirstNet activities. Increasing or decreasing hydrology in an area as an indirect effect, could lead to moisture stress and/or mortality of plant species that are adapted to specific hydrologic regimes. Indirect injury/mortality impacts vary depending on the species, time of year and duration of construction or deployment, though BMPs and mitigation measures could help to minimize or avoid the potential impacts.

Effects to Migration or Migratory Patterns

No effects to the long-term migration or migratory patterns for terrestrial vegetation (e.g., forest migration) are expected as a result of the Proposed Action given the small scale of deployment activities.

Reproductive Effects

No reproductive effects to terrestrial vegetation are expected as a result of the Proposed Action given the small scale of deployment activities.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or, depending on its ability to spread rapidly and outcompete native species, invasive. The introduction of invasive species could have a dramatic effect on natural resources and biodiversity. The Colorado Noxious Weed Act (CRS 35-5.5-101 through 119) stipulates that the Colorado Department of Agriculture (CDA) be responsible for the establishment of the statewide noxious weed list and updates to that list, as necessary. In addition, the Act further stipulates that each county may implement and enforce noxious weed management. The state provides funding for local entities to carry out management activities such as writing a management plan or carrying out management activities on the ground. Further, the state and counties involved coordinate with neighboring states to assist in preventing the spread of noxious weeds over state boundaries (Colorado Department of Agriculture, 2015a).

A total of 78 state-listed noxious weeds and 24 additional plants (Watch-List) are regulated in Colorado. Of these species, 86 of them are terrestrial and 14 are aquatic species (Colorado Department of Agriculture, 2015b). Four of these species occur on the Federal Noxious Weed List (USDA, 2014).

When non-native species are introduced into an ecosystem in which they did not evolve, their populations sometimes increase rapidly. Natural or native community species evolve together into an ecosystem with many checks and balances that limit the population growth of any one species. These checks and balances include such things as: predators, herbivores, diseases, parasites, and other organisms competing for the same resources and limiting environmental factors. However, when an organism is introduced into an ecosystem in which it did not evolve naturally, those limits may not exist and its numbers could sometimes dramatically increase. The unnaturally large population numbers could then have severe impacts to the environment, local economy, and human health. Invasive species can out-compete the native species for food and habitats and sometimes even cause their extinction. Even if natives are not completely eliminated, the ecosystem often becomes much less diverse.

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.

BMPs would help to minimize or avoid the potential for introducing invasive plant species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to terrestrial vegetation resources and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range impacts, from no impacts to less than significant impacts, depending on the deployment scenario or site-specific conditions. The terrestrial vegetation that would be affected would depend on the ecoregion, the species' phenology[157], and the nature as well as the extent of the habitats affected.

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 to terrestrial vegetation because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, attaching equipment to satellite launches for other purposes, and the use of portable devices that use satellite technology would not impact terrestrial vegetation because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are

[157] Phenology is the seasonal changes in plant and animal lifecycles, such as emergence of insects or migration of birds.

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. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public right-of-ways (ROWs) or private easements as well as the construction of access roads, POPs, huts, or facilities to house outside plant equipment could result in potential impacts to terrestrial vegetation. Impacts may vary depending on the number or individual poles installed, but could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in bodies of water would not impact terrestrial vegetation. However, impacts to terrestrial vegetation could potentially occur as a result of the construction of landings and/or facilities on shores or the banks of waterbodies that accept submarine cables as a result of land clearing, excavation activities, and heavy equipment use. Effects could include direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Implementation of BMPs and mitigation measures could help avoid or minimize potential impacts.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching,

and/or land clearing, such disturbance could result in direct or indirect injury to plants, the vegetation loss, and invasive species effects.

- Wireless Projects
  - New Wireless Communication Towers or Backhaul Equipment: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads), microwave facilities, or access roads could result in impacts to terrestrial vegetation. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to terrestrial vegetation. However, if new power units, replacement towers, structural hardening, and physical security measures require land clearing or excavation activities, impacts would be similar to new wireless construction.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in direct impacts to terrestrial vegetation if deployment occurs on vegetated areas, or the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects.

    Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact terrestrial vegetation if launching or recovery occurs on vegetated areas. Impacts would be similar to deployment of COWs, COLTs, and SOWs.

In general, the abovementioned activities could potentially involve land/vegetation clearing; topsoil removal; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or cables; heavy equipment movement; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to terrestrial vegetation associated with deployment of this infrastructure, depending on their scale, could include direct or indirect injury/mortality to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the vegetation affected. These impacts are expected to be less than significant due to the small-scale of expected deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.potential impacts

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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to terrestrial vegetation as a result of implementation of this alternative could be as described below.

Deployment Impacts

As described above, implementation of deployable technologies could result in less than significant impacts from land/vegetation clearing, excavation, and paving activities. These activities could result in direct or indirect injury to plants; the loss, alteration, or fragmentation of vegetative communities; and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts. However, impacts are expected to remain less than significant due to the relatively small scale of FirstNet activities at individual locations. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts to terrestrial vegetation associated with routine operations and maintenance due to the relatively small scale of likely FirstNet project sites. The impacts could vary greatly among species, vegetative community, and geographic region, but are expected to remain less than significant due to the small-scale nature of expected FirstNet activities in any particular location.

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 deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.3, Terrestrial Vegetation.

3.2.6.4. Wildlife

Impacts to amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates occurring in Colorado 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 3.2.6-1, less than significant impacts would be anticipated given the small size and nature of the majority of the proposed deployment activities. Although anthropogenic disturbances may be measurable (although minimal) for some FirstNet projects, impacts to individual behavior of animals would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed.

Terrestrial Mammals

Vehicle strikes are common sources of direct mortality or injury to both small and large mammals in Colorado. Mammals are attracted to roads for a variety of reasons including use as a source of minerals, preferred vegetation along roadways, areas of insect relief, and ease of travel along road corridors. Individual injury or mortality as a result of vehicle strikes associated with the Proposed Action could occur.

Entanglement in fences or other barriers could be a source of mortality or injury to terrestrial mammals, though entanglements would likely be isolated, individual events.

If bats, and particularly maternity colonies are present at a site location, removal of trees during land clearing activities could result in direct injury/mortality if bats are utilizing them as roost trees or for rearing young. The scale of this impact would be expected to be small and would be dependent on the location and type of deployment activity, and the amount of tree removal. Site avoidance measures could be implemented to avoid disturbance to bats.

Birds

Colorado is located within both the Central and Pacific Flyways. Mortalities from collisions or electrocutions with manmade cables and wires are environmental concerns for avian species and could violate MBTA and BGEPA. Generally, collision events occur to “poor” fliers (e.g., ducks), night-migrating birds, heavy birds (e.g., swans and cranes), and birds that fly in flocks; while species susceptible to electrocution are birds of prey, ravens, and thermal soarers, typically having large wing spans.

Avian mortalities or injuries could also result from vehicle strikes, although typically occur as isolated events.

Direct injury and mortality of birds could occur to ground-nesting birds when nests are either disturbed or destroyed during land clearing, excavation and trenching, and other ground disturbing activities. Removal of trees during land clearing activities, could also result in direct injury/mortality to forest dwelling birds if they are utilizing them as roost trees for nesting or shelter from predators and inclement weather, or as nest trees for rearing young. The scale of this impact would be associated with the amount of tree removal and the abundance of forest-dwelling birds roosting/nesting in the area. These impacts could be particularly pronounced in IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997). Direct injury/mortality are not anticipated to be widespread or affect bird populations due to the small scale of likely FirstNet actions.

Direct mortality and injury to birds of Colorado are not likely to be widespread or affect populations of species as a whole; individual species impacts may be realized depending on the nature of the deployment activity. If siting considerations and BMPs and mitigation measures are implemented (Chapter 19), 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 Colorado's amphibian and reptile species are widely distributed throughout Colorado. These species occur in a wide variety of habitats from the arid plains in the east to coniferous forests in the Rocky Mountains. Very few species are widespread throughout the state, and are instead more commonly found in either the plains region in the east or the mountainous region in the west. Direct mortality to amphibians or reptiles could occur in construction zones either by excavation activities or by vehicle strikes; however, these events are expected to be temporary and isolated, affecting only individual animals.

Terrestrial Invertebrates

The terrestrial invertebrate populations of Colorado 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.

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.

Potential effects of vegetation and habitat loss, alteration, or fragmentation are described for Colorado's wildlife species below.

Terrestrial Mammals

Mammals occupy a wide range of habitats throughout Colorado and may experience localized effects of habitat loss or fragmentation. Removal or loss of vegetation may impact large mammals by decreasing the availability of forest for cover from predators or foraging. Loss of cover may increase predation on both breeding adults as well as their young. The loss, alteration, or fragmentation of forested habitat would also impact some small mammals that utilize these areas for roosting, foraging, sheltering, and for rearing their young. Loss of habitat or exclusions from these areas could be avoided or minimized by implementing BMPs and mitigation measures.

Birds

The direct removal of migratory bird nests is prohibited under the MBTA. The USFWS and CDNR 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 locations, and cover habitat.

Noise disturbance and human activity, as discussed previously, could directly restrict birds from using their preferred resources. Greater human activity of longer duration would increase the likelihood that birds would avoid the area, possibly being excluded from essential resources. These impacts could be particularly pronounced if birds temporarily avoid IBAs within the state as these areas provide them with essential habitat that supports various life stages (Hill, et al., 1997).

The degree to which habitat exclusion affects birds depends on many factors. The impact to passerine[158] 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 stopover locations. 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 Colorado’s amphibians and reptiles typically consist of wetlands and upland forests. Impacts are expected to be less than significant due to the small-scale nature of expected FirstNet activities in any particular location. If proposed project sites were unable to avoid sensitive areas, BMPs and mitigation measures (see Chapter 19) could help to avoid or minimize the potential impacts.

Filling or draining of wetland breeding habitat (see Section 3.2.4, Water Resources) and alterations to ground or surface water flow from development associated with the Proposed Action may also have effects on Colorado’s amphibian and reptile populations, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.[159]

Terrestrial Invertebrates

Habitat loss and degradation are the most common causes of invertebrate species’ declines; however, habitat for many common terrestrial invertebrates is generally assumed to be abundant and widely distributed across the state, therefore no significant effects to terrestrial invertebrates are expected. Impacts to sensitive invertebrate species are discussed below in Section 3.2.6.6, Threatened and Endangered Species and Species of Concern.

[158]Passerines are an order of “perching” birds that have four toes, three facing forward, and one backward, which allows the bird to easily cling to both horizontal and nearly vertical perches.
[159] See Section 3.2.5, Wetlands, for a discussion of BMPs for wetlands.

Indirect Injury/Mortality

Indirect injury/mortality impacts vary depending on the species, time of year and duration of deployment, though BMPs and mitigation measures could help to avoid or minimize the potential impacts.

<u>Terrestrial Mammals</u>

Stress from repeated disturbances during critical time periods (e.g., roosting and mating) could reduce the overall fitness and productivity of young and adult terrestrial mammals. Indirect effects could occur result to roosting bats from noise, light, or human disturbance causing them to leave their roosting locations or excluding them from their summer roosting/maternity colony roosts. For example, some bat species establish summer roosting or maternity colonies in the same general area that they return to year and after year. The majority of FirstNet deployment activities would be short-term in nature; therefore, repeated disturbances would be unlikely to occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

<u>Birds</u>

Repeated disturbance, especially during the breeding and nesting season, could cause stress to individuals lowering fitness and productivity. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). The majority of FirstNet deployment activities would be short-term in nature; therefore, repeated disturbances would not occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

<u>Reptiles and Amphibians</u>

Changes in water quality and quantity, especially during the breeding seasons, could cause stress resulting in lower productivity. The majority of FirstNet deployment activities would be short-term in nature; therefore, repeated disturbances would be unlikely to occur. Depending on the project type and location, individual species may be disturbed resulting in less than significant impacts.

<u>Terrestrial Invertebrates</u>

Terrestrial invertebrates could experience chronic stress, either by changes in habitat composition or competition for resources, resulting in lower productivity. Due to the large number of invertebrates distributed throughout the state, and given the short-term nature of most of the deployment activities, this impact would likely be less than significant.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. Potential effects to migration patterns of Colorado’s amphibians and reptiles, terrestrial mammals, birds, and terrestrial invertebrates are described below.

Terrestrial Mammals

Large game animals have well-defined migratory routes. Route knowledge is passed on from one generation to the next and includes important feeding and calving areas. Small mammals also have migratory routes that include spring and fall roosting areas between their summer maternity roosts and hibernacula.[160] Any clearance, drilling, and construction activities needed for network deployment, including noise associated with these activities, has the potential to divert mammals from these migratory routes. Impacts could vary depending on the species, time of year of construction/operation, and duration, but are generally expected to be less than significant given the short-term nature and limited geographic scope for individual activities. Implementation of 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 vast distances often involving many different countries. Many migratory routes are passed from one generation to the next. Impacts could vary (e.g., mortality of individuals or abandonment of stopover sites by whole flocks) depending on the species, time of year of construction/operation, and duration, and impacts are expected to be less than significant due to the small-scale nature of expected FirstNet activities in any particular location. BMPs and mitigation measures could help to further avoid or minimize effects to migratory pathways.

Reptiles and Amphibians

Several species of tiger salamanders and the wood frog are known to seasonally migrate in Colorado. These amphibians often travel by the hundreds on their migration pathway that often crosses roadways. In Colorado, tiger salamanders are typically found in burrows in the forest floor or under rocks and stumps. During breeding season, tiger salamanders migrate to temporary ponds formed from rainwater or melted snow (Wentz, A., 2001). Wood frogs use diverse vegetation types from grassy meadows to open forests. After they emerge from dormancy, wood frogs migrate up 900 feet to breeding pools, where they breed rapidly in early spring in permanent or ephemeral water (Homan, et al., 2010). However, Berven and Grudzien (1990) found that a small percentage of juvenile wood frogs can migrate over 1.5 miles from natal ponds, suggesting juveniles may be capable of migrating relatively long distances (Berven, K. and T. Grudzien, 1990).

Species that use streams as dispersal or migratory corridors may be impacted if these waterways are restricted or altered, but the 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.

[160] A location chosen by an animal for hibernation

Terrestrial Invertebrates

The proposed deployment activities would be expected to be short-term or temporary in nature. No effects to migratory patterns of Colorado's terrestrial invertebrates are expected as a result of the Proposed Action.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals.

Terrestrial Mammals

Restricted access to important winter hibernacula or summer maternity roosts for bats and calving grounds for large mammals, such as the moose, has the potential to negatively affect body condition and reproductive success of mammals in Colorado.

Disturbance from deployment and operations could also result in the abandonment of offspring leading to reduced survival, although these activities are expected to be small scale and impacts are expected to be less than significant. Reproductive effects as a result of displacement and disturbance could be minimized through the use of BMPs and mitigation measures.

Birds

Impacts due to Proposed Action deployment and operations could include abandonment of the area and nests due to disturbance. Disturbance (visual and noise) may displace birds into less suitable habitat and thus reduce survival and reproduction. These impacts could be particularly pronounced in IBAs within the state if birds temporarily avoid those areas, since they provide essential habitat for various life stages (Hill, et al., 1997). These impacts are expected to be less than significant and if realized, would likely impact individual specimens as the majority of FirstNet deployment or operation activities are likely to be temporary and small scale in nature. FirstNet would try to avoid IBAs and other sensitive bird habitat where practicable and feasible. Additionally, BMPs and mitigation measures as defined through consultation with USFWS, if required, could help to avoid or minimize any potential impacts.

Reptiles and Amphibians

Reproductive effects to reptiles and amphibians may occur through direct loss or disturbance of nests. For example, species such as the spotted turtle (*Clemmys guttata*), rely on nesting sites for their reproductive cycle and direct loss or disturbance of nesting sites could disrupt such cycles.

Reproductive effects to sub-populations of amphibians and reptiles may occur through the direct loss of vernal pools as breeding habitat if deployment activities occur near breeding pools, alter water quality through sediment infiltration, or obstruction of natural water flow to pools, though impacts are expected to be less than significant because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Terrestrial Invertebrates

The majority of FirstNet deployment or operation activities are likely to be short-term in nature; no reproductive effects to terrestrial invertebrates are expected as a result of the Proposed Action.

Invasive Species Effects

When human activity results in a species entering an ecosystem new to it, the species is classified as introduced or invasive. The introduction of invasive species could have a dramatic effect on natural resources. Colorado has adopted regulations that prohibit or regulate the possession, transport, sale, barter, or trade of select wildlife species that are considered detrimental to native wildlife species; the prohibited species list includes 2 bird species and 17 mammal species (CRS 406-0:008.B).

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites although these sites are expected to return to their natural state in a year or two. Invasive species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers.

Potential invasive species effects to Colorado’s wildlife are described below.

Terrestrial Mammals

FirstNet deployment or operation activities could result in short-term or temporary changes to specific project sites, although these sites are expected to return to their natural state in a year or two. FirstNet deployment activities are not expected to introduce terrestrial mammal species to project sites as these activities are temporary and would not provide a mechanism for transport of invasive terrestrial mammals to project sites from other locations.

Birds

Invasive plant and pest species directly alter the landscape or habitat to a condition that is more favorable for an invasive species, and less favorable for native species and their habitats. 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.

Reptiles and Amphibians

Invasive plants and other pest species could adversely alter or degrade native habitats (e.g., wetlands) used by reptiles and amphibians. Although FirstNet deployment activities could result in short-term or temporary changes to specific project sites, these sites are expected to return to their natural state in a year or two. Invasive reptile or amphibian species are not expected to be introduced at project sites from machinery or laborers during deployment operations.

Terrestrial Invertebrates

Terrestrial invertebrate populations are susceptible to invasive plant species that may change or alter the community composition of specific plants on which they depend. Effects from invasive plant species to terrestrial invertebrates would be similar to those described for habitat loss and degradation.

Invasive insects in particular pose a large threat to Colorado's forest and agricultural resources (USFS, 2015g). Species such as the gypsy moth, hemlock woolly adelgid, Asian longhorn beetle, and emerald ash borer are of particular concern in Colorado and are known to cause irreversible damage to native forests. The potential to introduce invasive invertebrates within construction zones and during long-term site maintenance could occur from vehicles and equipment being transported from one region to another, or when conducting revegetation of a site after deployment activities are complete. Impacts are expected to be less than significant due to the limited amount of construction activities envisioned. BMPs and mitigation measures (see Chapter 19) could help to avoid or minimize the potential for introducing invasive plant species during implementation of the Proposed Action.

Potential Impacts of the Preferred Alternative

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

<u>Activities Likely to Have No Impacts</u>

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no impacts to 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 to wildlife resources because there would be no ground disturbance.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures, and the use of portable devices that use satellite technology would not impact wildlife because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact wildlife resources, it is anticipated that this activity would have no impact 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 facilitates to house outside plant equipment could result in potential impacts to wildlife resources. Impacts may vary depending on the number or individual poles installed and the extent of ground disturbance, but could include direct injury/mortality of individual species as described above; habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, habitat loss or alteration, effects to migratory patterns, indirect injury/mortality, and

invasive species effects. Noise disturbance from heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in migratory effects and indirect injury/mortality.

- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
- Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of wildlife as described for other New Build activities. Habitat loss, alteration and fragmentation; effects to migration or migratory patterns, indirect injury/mortality, and invasive species effects could occur as a result of construction and resulting disturbance.

- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to wildlife resources. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, habitat loss, alteration or fragmentation, and effects to migratory patterns. Security lighting and fencing could result in direct and/or indirect injury or mortality, effects to migratory patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower which would not result in impacts to wildlife. However, if new power units, replacement towers, or structural hardening are required, impacts would be similar to new wireless construction. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.
  - Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, and SOWs could result in direct injury/mortalities to wildlife on roadways. If external generators are used, noise disturbance could potentially impact migratory patterns of wildlife. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions.

    Deployment of drones, balloons, blimps, and piloted aircraft could potentially impact wildlife by direct or indirect injury/mortality from collision, entanglement, or ingestion and effects to migratory patterns and reproductive effects from disturbance and/or displacement due to noise. The magnitude of these effects depends on the timing and frequency of deployments. However, deployment activities are expected to be temporary and isolated, and likely affecting only a small number of wildlife.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers or poles; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to wildlife resources associated with deployment of this infrastructure are anticipated to be less than significant given the small scale of likely individual FirstNet projects; however, some deployment activities could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the project type, location, ecoregion, the species' phenology, and the nature and extent of the habitats affected. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts. The specific deployment activity and where the deployment will take place will be determined based on location-specific conditions and the results of site-specific environmental reviews. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The wildlife that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to wildlife resources associated with routine inspections of the Preferred Alternative. Site maintenance would be infrequent, including mowing or limited application of herbicides, may result in less than significant effects to wildlife including direct injury/mortality to less mobile wildlife, or exposure to contaminants from accidental spills from maintenance equipment or release of pesticides.

During operations, direct injury/mortality of wildlife could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms.

Wildlife resources could be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of terrestrial wildlife, particularly during migrations between winter and summer ranges or in calving areas.

In addition, the presence of new access roads and transmission line ROWs may increase human use of the surrounding areas, which could increase disturbance to wildlife resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. As stated above, these impacts would likely be limited to individual wildlife species and unlikely to cause population-level impacts, and therefore would likely be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to wildlife resources as a result of implementation of this alternative could be as described below.

<u>Deployment Impacts</u>

As described above, implementation of deployable technologies could result in less than significant impacts from direct and indirect injury or mortality events, changes in migratory patterns, disturbance, or displacement. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant because deployment activities are expected to be temporary, likely affecting only a small number of wildlife. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

<u>Operational Impacts</u>

As described above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be less than significant impacts because deployable activities are expected to be temporary and likely affecting only a small number of wildlife. The impacts could vary greatly among species and geographic region. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to wildlife resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.4, Terrestrial Wildlife.

3.2.6.5. Fisheries and Aquatic Habitats

Potential impacts to fisheries and aquatic habitats occurring in Colorado are discussed in this section.

Description of Environmental Concerns

Direct Injury/Mortality

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vessel strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events. (USEPA, 2012b)

Based on the impact significance criteria presented in Table 3.2.6-1, less than significant impacts would be anticipated given the size and nature of the majority of proposed deployment activities. Although anthropogenic disturbances may be measurable (but minimal) for some FirstNet projects, individual behavior of fish species would be short-term and direct injury or mortality impacts at the population-level or sub-population effects would not likely be observed. BMPs and mitigation measures could help to avoid or minimize potential impacts to fisheries and aquatic invertebrate population survival.

Vegetation and Habitat Loss, Alteration, or Fragmentation

Habitat impacts are primarily physical disturbances that result in alterations in the amount or quality of a habitat. As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the system and associated activities. Habitat fragmentation is the breaking down of continuous and connected habitat, and impeding access to resources and mates.

Depending on the location, construction of new infrastructure and long-term facility maintenance could result in the shoreline habitat alteration in localized areas; in some instances, the permanent loss of riparian vegetation could occur, which could lead to water quality impacts and in turn aquatic habitat alteration. Habitat loss is not likely to be widespread or affect populations of species as a whole; fish species would be expected to swim to a nearby location, depending on the nature of the deployment activity. Therefore, impacts are expected to be less than significant due to the small-scale and short term nature of deployment activities.

Indirect Injury/Mortality

Water quality impacts from exposure to contaminants from accidental spills from vehicles and equipment, and erosion or sedimentation from land clearing and excavation activities near or within riparian areas, floodplains, wetlands, streams, and other aquatic habitats could result in changes to habitat, food sources, or prey resulting in indirect mortality/injury to fish and aquatic invertebrates. Indirect injury/mortality impacts vary depending on the species, time of year, and duration of deployment. These impacts are expected to be less than significant due to the small-scale nature of expected FirstNet activities in any particular location. BMPs and mitigation measures to protect water resources (see Section 3.2.4, Water Resources) could help to minimize or avoid potential impacts.

Effects to Migration or Migratory Patterns

Migration is the regular movement of animals from one region to another and back again. Migratory patterns vary by species and sometimes within the same species. For example, restrictions or alterations to waterways could alter migration patterns, limit fish passage, or affect foraging and spawning site access. Impacts are expected to be less than significant, and are anticipated to be localized and at a small scale, and would vary depending on the species, time of year, and duration of deployment. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce an animal's ability to produce offspring or reduce the rates of growth, maturation, and survival of offspring, which could affect the overall population of individuals. Restrictions to spawning/breeding areas for fish and aquatic invertebrates and the alteration of water quality through sediment infiltration, obstruction of natural water flow, or loss of submerged vegetation resulting from the deployment of various types of infrastructure, are expected to be less than significant due to the small-scale nature of expected FirstNet activities in any particular location. BMPs and mitigation measures could help to further avoid or minimize the potential impacts.

Invasive Species Effects

Colorado has adopted regulations that prohibit or regulate the possession, transport, sale, barter, or trade of select wildlife species that are considered detrimental to native wildlife species; there are no prohibited fish species list identified (CRS 406-0:008.B). Invasive fish species are not expected to be introduced to project sites as part of the deployment activities from machinery or construction workers.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to fisheries and aquatic habitats and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

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 would be temporary and would not result in any perceptible change.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to fisheries and aquatic habitats because there would be no ground disturbance.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact fisheries and aquatic habitats because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact fisheries, it is anticipated that this activity would have no impact on fisheries.
  - Activities with the Potential to Have Impacts

Potential deployment-related impacts to fisheries and aquatic habitats as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including direct injury/mortality; vegetation and habitat loss, alteration, or fragmentation; effects to migratory patterns; indirect injury/mortality; reproductive effects; and invasive species effects. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to fisheries and aquatic habitats include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to fisheries and aquatic habitats. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other associated facilities, particularly if they occur adjacent to water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects. Implementation of BMPs and mitigation measures could help to avoid or minimize potential impacts.
  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to fisheries and aquatic habitats if activities occur near water resources that support fish. Impacts may vary depending on the number or individual poles installed or if access roads or stream crossings are needed, but could include habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening, if conducted near water resources that support fish, could result in habitat loss, alteration and fragmentation; indirect injury/mortality; and invasive species effects.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: 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, or replacement towers, structural hardening, or physical security measures require ground disturbance, impacts would be similar to new wireless construction. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.
- Deployable Technologies: Implementation of deployable technologies including COWs, COLTs, or SOWs could result in habitat loss, alteration and fragmentation; indirect injury/mortality, and invasive species effects if new access roads or other ground disturbing activities are necessary that generate erosion, sedimentation, or water quality impacts. For a discussion of RF emissions, refer to Section 2.4, Radio Frequency Emissions.

  Deployment of drones, balloons, blimps, or piloted aircraft could potentially impact fisheries and aquatic habitat if deployment occurs within or adjacent to water resources. The magnitude of these effects depends on the timing and frequency of deployments, and could result in result in habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to fisheries and aquatic habitats associated with deployment of this infrastructure could include direct injury/mortality, habitat loss, indirect injury/mortality, effects to migration, reproductive effects, and effects of invasive species depending on the ecoregion, the species' phenology, and the nature and extent of the habitats affected. These impacts are anticipated to be less than significant due to the small scale of deployment activities and the limited number of aquatic species expected to be impacted. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The fisheries and aquatic habitats that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

It is anticipated that there would be less than significant impacts to fisheries and aquatic habitats associated with routine inspections of the Preferred Alternative. Site maintenance that might include accidental spills from maintenance equipment or pesticide runoff near fish habitat are anticipated to result in less than significant effects to fisheries and aquatic habitats due to the limited nature of such activities and the likely small quantities of potentially harmful liquids used.

Fisheries and aquatic habitats could still be affected by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of fish passage. In addition, the presence of new access roads and transmission line ROWs near water resources that support fish may increase human use of the surrounding areas, which could increase disturbance to fisheries and aquatic habitats resulting in effects to migratory pathways, indirect injury/mortalities, reproductive effects, as well as the potential introduction and spread of invasive species as explained above. Fisheries and aquatic habitat may also be impacted if increased access leads to an increase in the legal or illegal take of biota. However, impacts are expected to be less than significant due to the small scale of expected activities with the potential to affect fisheries and aquatic habitat. As a result of the small scale, only a limited number of individuals are anticipated to be impacted, furthermore, habitat impacts would also be minimal in scale. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to fisheries and aquatic habitats as a result of implementation of this alternative could be as described below.

<u>Deployment Impacts</u>

As explained above, implementation of deployable technologies could result in less than significant impacts from habitat loss, alteration, and fragmentation; indirect injury/mortality, and invasive species effects. Greater frequency and duration of deployments could change the magnitude of impacts depending on species, life history, and region of the state. However, impacts are expected to remain less than significant due to the limited nature of expected deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operational Impacts

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, but they are still expected to remain less than significant due to the small scale of expected FirstNet activities in any particular location. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to fisheries and aquatic habitats as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.5, Fisheries and Aquatic Habitats.

3.2.6.6. Threatened and Endangered Species and Species of Conservation Concern

This section describes potential impacts to threatened and endangered species in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, 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.

Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on threatened and endangered species and their habitat were evaluated using the significance criteria presented in Table 3.2.6-2. The categories of impacts for threatened and endangered species and their habitats are defined as may affect, likely to adversely affect; may affect, not likely to adversely affect; and no effect. Characteristics of each effect type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes across the state, the potential impacts to threatened and endangered species addressed below are presented as a range of possible impacts.

Table 3.2.6-2: Impact Significance Rating Criteria for Threatened and Endangered Species

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Injury/Mortality of a Listed Species	Magnitude or Intensity	As per the ESA, this impact threshold applies at the individual level so applies to any mortality of a listed species and any impact that has more than a negligible potential to result in unpermitted take of an individual of a listed species. Excludes permitted take.	Does not apply in the case of mortality (any mortality unless related to authorized take falls under likely to adversely affect category). Applies to a negligible injury that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Includes permitted take.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent of mortality or any extent of injury that could result in take of a listed species.	Any geographic extent that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Any duration or frequency that does not meet the threshold of take due to its low level of effect and/or ability to fully mitigate the effect. Typically applies to infrequent, temporary, and short-term effects.	
Reproductive Effects	Magnitude or Intensity	Any reduction in breeding success of a listed species.	Changes in breeding behavior (e.g., minor change in breeding timing or location) that are not expected to result in reduced reproductive success.	No measurable effects on listed species.
	Geographic Extent	Reduced breeding success of a listed species at any geographic extent.	Changes in breeding behavior at any geographic extent that are not expected to result in reduced reproductive success of listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in reduced breeding success of a listed species.	Infrequent, temporary, or short-term changes in breeding behavior that do not reduce breeding success of a listed species within a breeding season.	

Type of Effect	Effect Characteristics	Impact Level		
		May Affect, Likely to Adversely Affect	**May Affect, Not Likely to Adversely Affect**	**No Effect**
Behavioral Changes	Magnitude or Intensity	Disruption of normal behavior patterns (e.g., breeding, feeding, or sheltering) that could result in take of a listed species.	Minor behavioral changes that would not result in take of a listed species.	No measurable effects on listed species.
	Geographic Extent	Any geographic extent that could result in take of a listed species.	Changes in behavior at any geographic scale that are not expected to result in take of a listed species. Typically applies to one or very few locations.	
	Duration or Frequency	Any duration or frequency that could result in take of a listed species.	Infrequent, temporary, or short-term changes that are not expected to result in take of a listed species.	
Loss or Degradation of Designated Critical Habitat	Magnitude or Intensity	Effects to any of the essential features of designated critical habitat that would diminish the value of the habitat for the survival and recovery of the listed species for which the habitat was designated.	Effects to designated critical habitat that would not diminish the functions or values of the habitat for the species for which the habitat was designated.	No measurable effects on designated critical habitat.
	Geographic Extent	Effects to designated critical habitat at any geographic extent that would diminish the value of the habitat for listed species. Note that the likely to adversely affect threshold for geographic extent depends on the nature of the effect. Some effects could occur at a large-scale but still not appreciably diminish the habitat function or value for a listed species. Other effects could occur at a very small geographic scale but have a large adverse effect on habitat value for a listed species.	Effects realized at any geographic extent that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to one or few locations within a designated critical habitat.	
	Duration or Frequency	Any duration or frequency that could result in reduction in critical habitat function or value for a listed species.	Any duration or frequency that would not diminish the functions and values of the habitat for which the habitat was designated. Typically applies to Infrequent, temporary, or short-term changes.	

Description of Environmental Concerns

Injury/Mortality of a Listed Species

Direct injury/mortality effects are physical injuries, extreme physiological stress, or death of an individual organism from interactions associated with the Proposed Action. The most common direct injuries are entanglement, vehicle strike, problems associated with accidental ingestion, and injuries incurred by sensitive animals from disturbance events.

Based on the impact significance criteria presented in Table 3.2.6-2, any direct injury or mortality of a listed species at the individual-level could be potentially significant as well as any impact that has more than a negligible potential to result in unpermitted take of an individual species at any geographic extent, duration, or frequency. Direct injury/mortality environmental concerns pertaining to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Colorado are described below.

Terrestrial Mammals

Direct mortality or injury (e.g., habitat fragmentation) to the threatened Canada lynx could occur from deployment activities in the high forests of the Colorado Rocky Mountains. Similarly, endangered New Mexico meadow jumping mouse and threatened Preble's meadow jumping mouse could be impact by deployment in riparian habitats. Entanglement in fences or other barriers could also be a source of mortality or injury to listed species. Impacts would likely be isolated, individual events.

BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

Among the two endangered and five threatened bird species in Colorado (Table 3.1.6-4), deployment activities in the prairie grasslands could impact the threatened Gunnison sage-grouse and lesser prairie-chicken. Activities in riparian regions of the state could impact the endangered least tern, threatened yellow-billed cuckoo, threatened piping plover, and endangered southwestern willow flycatcher; and activities in central Colorado’s forested mountains and canyonlands could impact the threatened Mexican spotted owl. Depending on the project type and location, direct mortality or injury to these birds could occur from collisions or electrocutions with cables and wires, vehicle strikes, or when nests are either disturbed or destroyed during land clearing, excavation, and trenching, and other ground disturbing activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed reptiles of amphibians occur in Colorado. Therefore, no direct injury or mortality of listed reptile or amphibian species is expected as a result of the Proposed Action in Colorado.

Fish

Deployment activities in or near Colorado rivers and streams could impact the endangered bonytail chub gila, Colorado pikeminnow (squawfish), humpback chub gila, and razorback sucker, as well as the threatened greenback cutthroat trout and candidate listed Arkansas darter. The most likely impact would be soil or sediment disturbance in or near waterways, which causes erosion and sedimentation that temporarily degrades the habitat of the listed fish species. However, the majority of FirstNet deployment projects would not occur in an aquatic environment. Direct mortality or injury to this species are unlikely but could occur from entanglements resulting from the Proposed Action. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Habitat of the endangered Uncompahgre fritillary butterfly and threatened Pawnee montane skipper could be impacted by land clearing or excavation activities associated with the Proposed Action. Distribution of these species is very limited throughout the state. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

Direct mortality or habitat impact to 16 federally listed plants could occur if land clearing or excavation activities associated with the Proposed Action are conducted, particularly in the arid shale soil and clay hill areas which provide habitat for some of Colorado's threatened and endangered plant species. In general, distribution of these species is limited throughout the state (Figure 3.1.6-3). BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reproductive Effects

Reproductive effects are considered those that either directly or indirectly reduce the breeding success of a listed species either by altering its breeding timing or location, or reducing the rates of growth, maturation, and survival of offspring, which could affect the breeding success.

Potential effects to federally listed terrestrial mammals, birds, terrestrial reptiles, amphibians, fish, invertebrates, and plants with known occurrence in Colorado are described below.

Terrestrial Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. Construction activities in the immediate area around a roost tree could startle federally listed bats causing them to abandon their roost tree. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Birds

Impacts to Gunnison sage-grouse, least tern, southwestern willow flycatcher, yellow-billed cuckoo habitat due to land clearing or excavation activities could directly affect nesting if deployment activities occur during the breeding/nesting season. In addition, habitat loss or degradation could lead to indirect affects to nesting due to birds having to find new nesting sites. Further, noise, light, or human disturbance within nesting areas could cause piping plovers or roseate terns to abandon their nests, relocate to less desirable locations, or cause stress to individuals reducing survival and reproduction. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed reptiles or amphibians occur in Colorado. Therefore, no reproductive effects to listed reptile or amphibian species are expected as a result of the Proposed Action in Colorado.

Fish

Deployment activities in the upstream portions of the Colorado River watersheds resulting in increased disturbance (e.g., humans, noise), especially during spawning activity, and changes in water quality could cause stress resulting in lower productivity (see Section 3.2.4, Water Resources, for a discussion of potential impacts to water resources). Effects to federally listed fish species in Kansas are unlikely as the majority of FirstNet deployment projects would not occur in an aquatic environment. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Changes in water quality from ground disturbing activities could degrade habitat, resulting in lower productivity for these federally listed fish. In addition, introduction of invasive fish and aquatic plants could indirectly affect fish populations, by changing habitat, increasing predation, or reducing the reproductive success of 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 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Plants

No reproductive effects to federally listed plants are expected as a result of the Proposed Action as limited pesticides would be used and avoidance measures could be undertaken.

Behavioral Changes

Effects to normal behavior patterns that could lead to disruptions in breeding, feeding, or sheltering, resulting in take of a listed species would be considered potentially significant. Potential effects to federally listed terrestrial mammals, birds, reptiles and amphibians, fish, invertebrates, and plants with known occurrence in Colorado are described below.

Mammals

Noise, light, and other human disturbances associated with the Proposed Action could adversely affect federally listed terrestrial mammals within or in the vicinity of Project activities. Impacts would be directly related to the frequency, intensity, and duration of these activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, 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.

Birds

Because many birds have extremely long migrations, protection efforts for critical sites along migratory routes must be coordinated over vast distances often involving many different countries. Disturbance in stopover locations, 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 adverse effects to federally listed birds, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

Reptiles and Amphibians

No federally listed reptiles or amphibians occur in Colorado. Therefore, no behavioral impacts to listed reptile or amphibian species are expected as a result of the Proposed Action in Colorado.

Fish

Changes in water quality and quantity could impact foraging and reproductive success of the Arkansas darter, bonytail chub, Colorado pikeminnow (squawfish), Greenback cutthroat trout, humpback chub, and the razorback sucker. Further, increased human disturbance and noise could cause stress causing them to abandon spawning locations or altering migration patterns, though BMPs and mitigation measures would help to avoid or minimize the potential impacts.

<u>Invertebrates</u>

Loss or alternation of habitat for the Arapahoe snowfly, Pawnee montane skipper, and Uncompahgre fritillary butterfly could impact these federally listed insects, resulting in behavior changes, lower productivity, and population loss. BMPs and mitigation measures would help to minimize potential impacts to federally listed species resulting from the Proposed Action (see below).

<u>Plants</u>

No behavioral effects to federally listed plants are expected as a result of the Proposed Action.

Loss or Degradation of Designated Critical Habitat

Effects to designated critical habitat and any of its essential features that could diminish the value of the habitat for the listed species or its survival and recovery would be considered an adverse effect and could be potentially significant. Depending on the species or habitat, the adverse effect threshold would vary for geographic extant. 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. For example, impacts to designated critical habitat for a listed species that is only known to occur in one specific location geographically. Potential effects to federally listed terrestrial mammals, birds, fish, invertebrates, and plants with designated critical habitat in Colorado are described below.

<u>Terrestrial Mammals</u>

Critical habitat has been designated for the New Mexico meadow jumping mouse in the southwest corner to Colorado, and for the Preble's meadow jumping mouse in the north central part of the state (Figure 3.1.6-3). Land clearing, excavation activities, and other ground disturbing activities in these regions of could lead to habitat loss or degradation, which could lead to adverse effects to the two listed species depending on the duration, location, and spatial scale of the associated activities. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

<u>Birds</u>

Critical habitat has been designated for the Gunnison sage-grouse, Mexican spotted owl, Southwestern willow flycatcher, and Yellow-billed Cuckoo in Colorado (Figure 3.1.6-3). Potential impacts to these species could occur with the loss or degradation of designated critical habitat. Land clearing, excavation activities, and other ground disturbing activities in this region of Colorado may affect, but are not likely to adversely effect, federally listed birds. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Reptiles and Amphibians

No federally listed reptiles or amphibians occur in Colorado. Therefore, no loss or degradation of critical habitat to listed reptile or amphibian species are expected as a result of the Proposed Action in Colorado.

Fish

Critical habitat has been designated for the bonytail chub in northwestern Colorado, and for the Humpback chub, Colorado Pikeminnow (Squawfish), and the Razorback sucker in western Colorado (Figure 3.1.6-3). Potential impacts to these threatened and endangered species could occur from the loss or degradation of designated critical habitat as a result of the Proposed Action. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Invertebrates

Loss or alternation of designated critical habitat for the Arapahoe snowfly could impact these federally listed insects, resulting in lower productivity and population loss. BMPs and mitigation measures would help to minimize potential impacts to federally listed species resulting from the Proposed Action.

Plants

Designated critical habitat occurs for the clay-loving wild buckwheat, DeBeque phacelia, Pagosa skyrocket, and parachute beardtongue in Colorado (Figure 3.1.6-3). Therefore, the loss or degradation of designated critical habitat could potentially impact threatened and endangered species. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to threatened and endangered species and others would not. In addition, and as explained in this section, the same type of Proposed Action infrastructure could result in a range of no affect to may affect but not likely to adversely affect depending on the deployment scenario or site-specific conditions. The threatened and endangered species that would be affected would depend on the ecoregion, the species' phenology, and the nature and extent of the habitats affected.

Activities Likely to Have No Effect

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are expected to have no effect to threatened and endangered species or their habitat under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance, including noise, associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Although threatened and endangered species and their habitat could be impacted, it is anticipated that effects to threatened and endangered species would be temporary, infrequent, and likely not conducted in locations designated as vital or critical for any period.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to threatened and endangered species or their habitat because there would be no ground disturbance and very limited human activity.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact threatened or endangered species because those activities would not require ground disturbance.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact protected species, it is anticipated that this activity would have no impact 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 impacts that could occur, including direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential effects to threatened and endangered species include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing, trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to threatened and endangered species. Land/vegetation clearing and excavation activities, associated with construction of POPs, huts, or other

associated facilities could result in direct injury/mortalities of threatened and endangered species that are not mobile enough to avoid construction activities (e.g., reptiles, mollusks, small mammals, and young), that utilize burrows (e.g., ground squirrels), or that are defending 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. Implementation of BMPs and mitigation measures developed through consultation with the appropriate resource agency could help to avoid or minimize potential impacts.

  - New Build – Aerial Fiber Optic Plant: The installation of new poles and hanging cable and associated security, safety, or public lighting components on public ROWs or private easements as well as the construction of access roads, POPs, huts, or facilitates to house outside plant equipment could result in potential impacts to threatened and endangered species and their habitat. Impacts may vary depending on the number or individual poles installed, but could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat.
  - Collocation on Existing Aerial Fiber Optic Plant: Land clearing and excavation during replacement of poles and structural hardening could result in direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat to threatened and endangered species. Noise 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 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 shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts, there would be no impacts to threatened and endangered species or their habitats. If installation of transmission equipment required construction of access roads, trenching, and/or land clearing, such disturbance could result in direct injury/mortality of threatened and endangered species as described for other New Build activities. Reproductive effects, behavioral changes, and loss/degradation of designated critical habitat could also occur as a result of construction and resulting disturbance.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to threatened and endangered species and their habitat. Land/vegetation clearing, excavation activities, landscape grading, and other disturbance activities during the installation of new wireless towers and associated structures or access roads could result in direct injury/mortality, reproductive effects, behavioral changes, and

loss/degradation of designated critical habitat. Security lighting and fencing could result in direct injury/mortality, disruption of normal behavior patterns, as well as reproductive effects. For a discussion of radio frequency emissions, refer to Section 2.4, 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; FirstNet activities would be infrequent, temporary, or short-term in nature and are unlikely to result in direct injury/mortality or behavioral changes to threatened and endangered species. However, if replacement towers or structural hardening are required, impacts could be similar to new wireless construction. Hazards related security/safety lighting and fencing may produce direct injury/mortality, reproductive effects, and behavioral changes. For a discussion of radio frequency emissions, refer to Section 2.4, RF Emissions.
- Deployable Technologies: Implementation of land-based deployable technologies including COWs, COLTs, or SOWs could result in direct injury/mortalities to threatened and endangered species on roadways. If external generators are used, noise disturbance could potentially result in reproductive effects or behavioral changes to threatened and endangered species. For a discussion of radio frequency emissions, refer to Section 2.4, RF Emissions. Deployment of drones, balloons, piloted aircraft, or blimps could potentially impact threatened and endangered species by direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat. The magnitude of these effects depends on the timing and frequency of deployments.

In general, the abovementioned activities could potentially involve land/vegetation clearing; excavation and trenching; construction of access roads; installation or restructuring of towers, poles, or underwater cables; installation of security/safety lighting and fencing; and deployment of aerial platforms. Potential impacts to threatened and endangered species associated with deployment of this infrastructure could include direct injury/mortality, reproductive effects, behavioral changes, and loss/degradation of designated critical habitat depending on the species' phenology and the nature and extent of the habitats affected. These impacts may affect, but are not likely adversely affect protected species. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operational activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. The threatened and endangered species that would be affected would depend on the species' phenology and the nature and extent of the habitats affected.

It is anticipated that operational impacts may affect, but are not likely to adversely affect threatened and endangered species due to routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Site maintenance, including mowing or application of herbicides, may affect, but are not likely to adversely affect threatened and endangered species, as they would be conducted infrequently and in compliance with BMPs and mitigation measures developed through consultation with the appropriate resource agency.

During operations, direct injury/mortality of threatened and endangered species could occur from collisions and/or entanglements with transmission lines, towers, and aerial platforms. Listed species may be affected, but are not likely to be adversely affected. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Chapter 19, 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.

Threatened and endangered species may be affected, but are not likely to be adversely affected, by the reduction in habitat quality associated with habitat fragmentation from the presence of access roads, transmission corridors, and support facilities. These features could also continue to disrupt movements of some species, particularly during migrations between winter and summer ranges. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to threatened and endangered species as a result of implementation of this alternative could be as described below.

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. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

Operational Impacts

As explained above, operational activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that activities may affect, but are not likely to adversely affect, threatened and endangered species and their habitats as a result of routine operations, management, and monitoring. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented. Additional BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures, may be implemented as appropriate to further minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the nationwide, interoperable, public safety broadband network would not be deployed; therefore there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no effects to threatened and endangered species as a result of construction and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.6.6, Threatened and Endangered Species and Species of Conservation Concern.

3.2.7. Land Use, Recreation, and Airspace

3.2.7.1. Introduction

This section describes potential impacts to land use, recreation, and airspace resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.7.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on land use, recreation, and airspace resources were evaluated using the significance criteria presented in Table 3.2.7-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact.

Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to land use, recreation, and airspace resources addressed in this section are presented as a range of possible impacts.

Table 3.2.7-1: Impact Significance Rating Criteria for Land Use, Recreation, and Airspace

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with 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

3.2.7.3. Description of Environmental Concerns

Direct Land Use Change

Changes in land use could be influenced by the deployment, operation, and maintenance of facilities or other infrastructure, and the acquisition of ROWs or easements. 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 3.2.7-1, less than significant impacts would be anticipated given the size and nature of the majority of the proposed deployment activities. Direct land use changes would be minimized and isolated at specific locations and all required permits would likely 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 ROWs or easement. The deployment, operation, and maintenance of structures, towers, roads, and other permanent features could conflict with surrounding land use patterns and options for surrounding land uses. The installation of poles, towers, structures, or other aboveground facilities or assets could have short- or long-term effects to surrounding land use patterns or options for surrounding land uses based on the characteristics of the structures or facilities, such as the location, type, or height. In addition, the acquisition of ROWs or easements and the construction of roads to access facilities and locations could influence changes in surrounding land uses. The effects from these actions would depend on the geographic location; compatibility with surrounding land uses; and characteristics of the ROW, easement, or access road. These characteristics, such as the length, width, and location could conflict with surrounding land use patterns or restrict options for surrounding land uses.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as any new land use would be small scale and 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 but these impacts are expected to be less than significant due to the short duration of deployment activities. In the long-term, the deployment and installation of poles, towers, structures, or other aboveground facilities could alter the types and locations of recreation activities.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as restricted access or a loss of access to recreation areas would not occur; only short-term impacts or small-scale limitations during the construction phase would be expected.

Loss of Enjoyment of Public or Private Recreation Land

The deployment of new towers, and the resulting built tower, could influence the enjoyment of public or private recreation land. Crews accessing the site during the deployment and maintenance of structures, towers, roads, and other permanent features could temporarily impact enjoyment of recreation land. The deployment of poles, towers, structures, or other aboveground facilities could affect the enjoyment of recreational land based on the characteristics of the structures or facilities, including permanent impacts to scenery, short-term noise impacts, and the presence of deployment or maintenance crews.

Based on the impact significance criteria presented in Table 3.2.7-1, less than significant impacts would be anticipated as only small reductions, if any, in recreational visits or durations would occur due to the relatively small-scale nature of likely FirstNet activities. Only short-term impacts during the construction phase would be expected.

Use of Airspace

Primary concerns to airspace include the following: if aspects of the Proposed Action would result in violation of FAA regulations; undermine the safety of civilian, military, or commercial aviation; or infringe on flight activity and flight corridors. Potential impacts could include air routes or flight paths, available flight altitudes, disruption of normal flight patterns, and restrictions to flight activities. Construction of new towers or alternations to existing towers could, but are not likely to, obstruct navigable airspace in the state. Use of aerial technologies could result in SUA considerations.

Based on impact significance criteria presented in Table 3.2.7-1, airspace impacts are not likely to change or alter flight patterns or airspace usage. Drones, balloons, and piloted aircraft would likely only be deployed in an emergency and for a short period, FirstNet would not impact airspace resources

3.2.7.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, 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.

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 ROWs.
        - <u>Land Use:</u> See Activities Likely to Have Impacts below.
        - <u>Recreation:</u> See Activities Likely to Have Impacts below.
        - <u>Airspace:</u> No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 3.1.7.5 Obstructions to Airspace Considerations).
    - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas.
        - <u>Land Use:</u> It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
        - <u>Recreation:</u> See Activities Likely to Have Impacts below.
        - <u>Airspace:</u> It is anticipated that there would be no impacts to airspace since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 3.1.7.5 Obstructions to Airspace Considerations).
    - New Build – Aerial Fiber Optic Plant: Installing new poles and hanging cables on previously disturbed or new (undisturbed) ROWs or easements and the potential construction of access roads.
        - <u>Land Use:</u> See Activities Likely to Have Impacts below.
        - <u>Recreation</u>: See Activities Likely to Have Impacts below.

    - Airspace: Installation of new poles would not have an effect on airspace because utility poles are an average of 40 feet in height and do not intrude into useable airspace.
- Collocation on Existing Aerial Fiber Optic Plant: Installation of new fiber on existing poles would be limited to previously disturbed areas.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities that would be conducted would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: No impacts to recreation would be anticipated since the activities that would be conducted would not cause disruption or loss of access to recreational lands or activities or the enjoyment of those lands or activities.
    - Airspace: No impacts are anticipated to airspace from collocations.
- Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting of dark fiber and installation of new equipment in existing huts.
    - Land Use: It is anticipated that there would be no impacts to land use since the activities would not directly or indirectly result in changes to existing and surrounding land uses.
    - Recreation: Use of existing dark fiber would not impact recreation because it would not impede access to recreational resources.
    - Airspace: Lighting of dark fiber would have no impacts to airspace.
- New Build – Submarine Fiber Optic Plant: Installing cables in limited nearshore and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: The installation of cables in limited nearshore and inland bodies of water and construction of landings/facilities would not impact flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 3.1.7.5 Obstructions to Airspace Considerations).
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment would occur in existing boxes or huts. The section below addresses potential impacts to land use, recreation resources, and airspace if deployment of new boxes, huts, or access roads is required.
    - Land Use: See Activities Likely to Have Impacts below.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: No impacts to airspace would be anticipated since the activities would not affect flight patterns or cause obstructions that would require FAA and/or state review based on FAR 14 CFR, Part 77, *Safe, Efficient Use, and Preservation of the Navigable Airspace* (See Section 3.1.7.5 Obstructions to Airspace Considerations).

- Wireless Projects
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower, structure, or building.
    - Land Use: There would be no impacts to existing and surrounding land uses. The potential addition of power units, structural hardening, and physical security measures would not impact existing or surrounding land uses.
    - Recreation: See Activities Likely to Have Impacts below.
    - Airspace: See Activities Likely to Have Impacts below.
- Deployable Technologies
  - Deployable Technologies: These technologies would be used where permanent, fixed infrastructure cannot be deployed due to a variety of factors such as the need to supplement coverage or to avoid or mitigate permanent impacts to sensitive resources or receptors.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: No impacts to recreation are anticipated, as deployable technologies would not affect the use or enjoyment of recreational lands.
    - Airspace: Use of land-based deployable technologies (COW, COLT, and SOW) is not expected to result in impacts to airspace, provided antenna masts do not exceed 200 feet Above Ground Level (AGL) or do not trigger any of the other FAA obstruction to airspace criteria listed in Section 3.1.7.5 Obstructions to Airspace Considerations.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: Installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: It is anticipated that there would be no impacts to existing or surrounding land uses because these technologies would be temporarily located in areas compatible with other land uses.
    - Recreation: It is anticipated that there would be no impacts to recreational uses because these technologies would be temporarily deployed but would not restrict access to, or enjoyment of, recreational lands.
    - Airspace: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact airspace because those activities would not result in changes to flight patterns and airspace usage or result in obstructions to airspace.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact to land use, it is anticipated that this activity would have no impact on land use.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to land use, recreation resources, or airspace as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur, including changes to existing and surrounding land uses. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to land use resources include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring alongside the road in utility corridors or within public road ROWs.
        - 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 and inland bodies of water and the constructing landings and/or facilities on shore to accept submarine cable.
        - Land Use: Deployment activities could temporarily restrict existing and surrounding land uses at isolated locations. New landings and/or facilities on shore could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
        - Recreation: Deployment may temporarily restrict recreation on or within limited nearshore and inland bodies of water and the surrounding area during the deployment phase. Reductions in visitation may result during deployment.
        - Airspace: No impacts are anticipated – see previous section.

- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of equipment including construction of new boxes, huts, or access roads.
  - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New boxes, huts, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
  - Recreation: Deployment of installation equipment and the construction of boxes, huts, or access roads may restrict access to recreation land or activities. Reductions in visitation during deployment may occur.
  - Airspace: No impacts are anticipated – see previous section.

- Wireless Projects
  - New Wireless Communication Towers: Installing new wireless towers, associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads.
    - Land Use: Construction activities could temporarily restrict existing and surrounding land uses at isolated locations. New wireless towers, associated structures, or access roads could have long-term impacts to existing and surrounding land uses. The magnitude of the impact would depend on the specific location and the compatibility of the new facilities with existing and surrounding land uses.
    - Recreation: Deployment of new towers and associated structures could result in temporary, localized restricted access for recreation land or activities for the duration of the deployment phase. Reductions in visitation or duration of recreational activity may result from restricted access.
    - Airspace: Installation of new wireless towers could result in impacts to airspace if towers exceed 200 feet AGL or meets the other criteria listed in Section 3.1.7.5 Obstructions to Airspace Considerations. An OE/AAA could be required for the FAA to determine if the proposed construction does affect navigable airways or flight patterns of an airport if the aerial fiber optic plant is located in proximity to one of Colorado’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 Colorado airports (See obstruction criteria in Section 3.10.5.3 Obstructions to Airspace Considerations). Potential impacts to airspace (such as SUAs and MTRs) may be possible depending on the planned use of drones, piloted aircraft, untethered balloons, and blimps (e.g., frequency of deployment, altitudes, proximity to airports and airspaces classes/types, length of deployment, etc.). Coordination with the FAA would be required to determine the actual impact and the required certifications. It is expected that FirstNet would attempt to avoid changes to airspace and the flight profiles (boundaries, flight altitudes, operating hours, etc.).
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The installation of permanent equipment on existing structures and the use of portable devices that use satellite technology.
    - Land Use: No impacts 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 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for temporary, short-term inspections because there would be no ground disturbance, no airspace activity, and no access restrictions to recreational lands. If routine maintenance or inspection activities would conflict with existing or surrounding land uses, impact recreation resources, or conflict with airspace, impacts could result as explained above. Operation of the Deployable Technologies options of the Preferred Alternative could result in the temporary presence of deployable vehicles and equipment (including airborne equipment), potentially for up to two years in some cases. The degree of change in the visual environment (see Section 3.2.8, Visual Resources)—and therefore the potential indirect impact on a landowner's ability to use or sell of their land as desired—would be highly dependent on the specific deployment location and length of deployment. 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. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.7.5. Alternatives Impact Assessment

The following section assesses potential impacts to land use, recreation resources, and airspace associated with the Deployable Technologies Alternative and the No Action Alternative.

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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to land use, recreation resources, or airspace associated with routine inspections of the Deployable Technologies Alternative, assuming that the same access roads used for deployment are also used for inspections. Operation of deployable technologies would result in land use, land ownership, airspace, and recreation (access and enjoyment) similar in type to those described for the Preferred Alternative. The frequency and extent of those potential impacts would be greater than for the Proposed Action because under this Alternative, deployable technologies would be the only options available. As a result, this alternative would require a larger number of terrestrial and airborne deployable vehicles and a larger number of deployment locations in—all of which would potentially affect a larger number of properties and/or areas of airspace. Overall these potential impacts would be less than significant due to the temporary nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to land use, recreation resources, or airspace. Environmental conditions would therefore be the same as those described in Section 3.1.7, Land Use, Recreation, and Airspace.

3.2.8. Visual Resources

3.2.8.1. Introduction

This section describes potential impacts to visual resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.8.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on visual resources were evaluated using the significance criteria presented in Table 3.2.8-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to visual resources addressed in this section are presented as a range of possible impacts.

Table 3.2.8-1: Impact Significance Rating Criteria for Visual Resources

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Adverse change in aesthetic character of scenic resources or viewsheds	Magnitude or Intensity	Fundamental and irreversibly negative change in aesthetic character.	Effect that is potentially significant, but with mitigation is less than significant.	Intermittently noticeable change in aesthetic character that is marginally negative.	No visible effects.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to aesthetic character lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but aesthetics of the area would be returned to original state following the construction and deployment phase.	Transient or no visible effects.
Nighttime lighting	Magnitude or Intensity	Lighting dramatically alters night-sky conditions.	Effect that is potentially significant, but with mitigation is less than significant.	Lighting alters night-sky conditions to a degree that is only intermittently noticeable.	Lighting does not noticeably alter night-sky conditions.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	No visible effects.
	Duration or Frequency	Permanent or persistent changes to night-sky conditions lasting throughout or beyond the construction or deployment phase.		Persisting through the construction and deployment phase, but lighting would be removed and night-sky conditions would be returned to original state following the construction and deployment phase.	Transient or no visible effects.

NA = Not Applicable

3.2.8.3. Description of Environmental Concerns

Adverse Change in Aesthetic Character of Scenic Resources or Viewsheds

A primary concern during and following construction of structures, towers, roads or other permanent features is the long-term disruption of scenery and viewsheds. In Colorado, residents and visitors travel to many national and state parks, such as the Rocky Mountains, for scenic vistas and recreational activities. If lands considered visually significant or scenic were subject to vegetation loss or removal, short- or long-term effects to viewsheds or scenic resources could occur. Bare ground or interruption of a landscape due to vegetation removal could be considered an adverse change in the aesthetic character of scenic resources or viewsheds. New towers or structures constructed within scenic areas could disrupt the perceived aesthetic character or scenery of an area. If new towers were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas.

Based on the impact significance criteria presented in Table 3.2.8-1, impacts to the aesthetic character of scenic resources or viewsheds would be considered potentially significant if landscapes were permanently removed or fragmented, or if damage to historic or cultural resources occurred. Given the small scale of likely FirstNet activities, impacts are expected to be less than significant.

Nighttime Lighting

If new towers or facilities were constructed to a height that required lighting, nighttime vistas could be affected in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility that caused regional impacts or permanent changes to night sky conditions, those effects would be considered potentially significant.

Based on the impact significance criteria presented in Table 3.2.8 1, lighting that illuminates the night sky, diminishes night sky viewing over long distances, and persists over the long-term would be considered potentially significant. Although likely FirstNet actions are expected to be small-scale, certain discrete locations may experience potentially significant impacts to night skies, although potentially minimized to less than significant with implementation of BMPs and mitigation measures, as defined in Chapter 19, BMPs and Mitigation Measures. BMPs and mitigation measures, as defined through consultation with the appropriate resource agency, would be implemented.

Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure.

Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to visual resources and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to visual resources under the conditions described below:

- Wired Projects
  - Collocation on Existing Aerial Fiber Optic Plant: While the addition of new aerial fiber optic plant to an existing aerial fiber optic transmission system would likely be visible, the change associated with this option is so small as to be essentially imperceptible. This option would involve no new nighttime lighting and pole replacement would be limited.
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to visual resources since the activities would be conducted at small entry and exit points and are not likely to produce perceptible changes, and would not require nighttime lighting.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to visual resources because there would be no ground disturbance, would not require nighttime lighting, and would not produce any perceptible changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact visual resources since those activities would not require ground disturbance or vegetation removal.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact visual resources, it is anticipated that this activity would have no impact on visual resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to visual resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance, vegetation removal, or installation of permanent structures if development occurs in scenic areas. The types of deployment activities that could be part of the Preferred Alternative and result in potential impacts to visual resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to visual resources. The degree of impact would depend on the timing, location, and type of project; installation of a hut or POP would be permanent, whereas ground disturbing activities would be short-term. In most cases, development located next to existing roadways would not affect visual resources unless vegetation were removed or excavation occurred in scenic areas.
  - New Build – Aerial Fiber Optic Plant: Construction and installation of new or replacement poles and hanging cables could result in impacts to the aesthetic character of scenic resources or viewsheds depending on the location of the installation. In most cases, development in public ROWs would not affect visual resources unless vegetation were removed or construction occurred in scenic areas. If new lighting were necessary, impacts to night skies could occur. Construction of new roadways could result in linear disruptions to the landscape, surface disturbance, and vegetation removal; all of which could impact the aesthetic character of scenic resources or viewsheds, depending on the location of the installation.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment required grading, vegetation removal, or other ground disturbance to install small boxes or huts, or access roads, potential impacts to visual resources could occur but effects would be temporary and localized.
- Wireless Projects
  - New Wireless Communication Towers: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to visual resources. Land/vegetation clearing, excavation activities, landscape grading, and other surface disturbing activities during the installation of new wireless towers and associated structures or access roads could result in the degradation of the aesthetic character of scenic resources or viewsheds. Impacts may be experienced by viewers if new towers were located in or near a national park unit or other sensitive area. If new towers were constructed to a height that required aviation lighting, nighttime vistas could be impacted in areas where the night skies do not have light disruptions or are within unpopulated areas. If nighttime lighting were necessary for the operation or function of a facility, impacts to night sky conditions could occur.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower and would not likely result in additional impacts to visual resources.

However, if additional power units, structural hardening, or physical security measures required ground disturbance or removal of vegetation, impacts to the aesthetic character of scenic resources or viewsheds could occur.

- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to visual resources if long-term deployment occurs in scenic areas, or if the implementation requires minor construction of staging or landing areas, results in vegetation removal, areas of surface disturbance, or additional nighttime lightning.

In general, the abovementioned activities could potentially involve land/vegetation clearing, and potential scenic intrusion of towers, poles, roads, infrastructure, and other structures. Potential impacts to visual resources associated with deployment could include interruptions of landscapes, degradation of the aesthetic character of scenic resources or viewsheds, and overall changes in valued scenic resources, particularly for permanent fixtures such as towers or facilities. These impacts are expected to be less than significant due to the temporary and small-scale nature of deployment activities. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. Nighttime lighting in isolated rural areas or if sited near a national park would be less than significant with BMPs and mitigation measures incorporated during operations. Additionally, FirstNet would work closely with the National Park Service (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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.8.4. 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to visual resources associated with routine inspections of the Preferred Alternative, assuming that the same access roads used for deployment are also used for inspections. The potential visual impacts—including aesthetic conditions and nighttime lighting—of the operation of deployable technologies would be less than significant. These potential impacts would be similar to the potential impacts described for the Deployable Technologies option of the Preferred Alternative, above, only likely with greater numbers of deployable units. Chapter 19, 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 visual resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.8, Visual Resources.

3.2.9. Socioeconomics

3.2.9.1. Introduction

This section describes potential impacts to socioeconomics in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and

Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.9.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on socioeconomics were evaluated using the significance criteria presented in Table 3.2.9-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to socioeconomics addressed in this section are presented as a range of possible impacts.

Table 3.2.9-1: Impact Significance Rating Criteria for Socioeconomics

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Impacts to real estate (could be positive or negative)	Magnitude or Intensity	Changes in property values and/or rental fees, constituting a significant market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible impact to property values and/or rental fees.	No impacts to real estate in the form of changes to property values or rental fees.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes to spending, income, industries, and public revenues	Magnitude or Intensity	Economic change that constitutes a market shift.	Effect that is potentially significant, but with mitigation is less than significant.	Indiscernible economic change.	No change to tax revenues, wages, major industries, or direct spending.
	Geographic Extent	Regional impacts observed throughout the state/ territory.		Effects realized at one or multiple isolated cities/towns.	NA
	Duration or Frequency	Persists during or beyond the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Impacts to employment	Magnitude or Intensity	High level of job creation at the state or territory level.	Effect that is potentially significant, but with mitigation is less than significant.	Low level of job creation at the state/territory level.	No job creation due to project activities at the state/territory level.
	Geographic Extent	Regional impacts observed throughout the state/territory.		Effects realized at one or multiple isolated cities/towns.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA
Changes in population number or composition	Magnitude or Intensity	Substantial increases in population, or changes in population composition (age, race, gender).	Effect that is potentially significant, but with mitigation is less than significant.	Minor increases in population or population composition.	No changes in population or population composition.
	Geographic Extent	Regional impacts observed throughout the state or territory.		Effects realized at one or multiple isolated locations.	NA
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

3.2.9.3. Description of Environmental Concerns

This section discusses at a high level the types of socioeconomic impacts that could result from deployment of the NPSBN. Socioeconomic impacts could be negative or positive. Subsections below address socioeconomic impacts in four general areas, following the breakdown of the significance rating criteria in the table above:

- Impacts to Real Estate;
- Economic Benefits or Adverse Impacts related to Changes in Spending, Income, Industries, and Public Revenues;
- Impacts to Employment; and
- Changes in Population Number or Composition.

In addition to the specific impacts noted below, the Proposed Action would likely have broad, beneficial impacts to all four areas in times of disaster, by improving the response of public safety personnel. Reduced damages and faster recovery would result. This would support property values; maintain corporate income, personal income, and government revenues; preserve jobs; and reduce disruptions to populations.

Impacts to Real Estate

Deployment of the NPSBN has the potential to improve property values in areas that have property values lower than typical market values due to below average public safety communication services. Improved services would reduce response times and improve responses (provide a better fit of the response to the need). 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 Colorado. Median values of owner-occupied housing units in the 2009–2013 period ranged from over $470,000 in the greater Boulder area, to just over $129,000 in the Pueblo area (U.S. Census Bureau, 2015o). These figures are general indicators only. Property values are probably both higher and lower in specific localities. Any property value effects of deployment of the NPSBN would occur at a localized level.

Some telecommunications infrastructure, such as wireless communications towers, may adversely affect property values, depending on infrastructure location and other characteristics. Researchers believe these negative impacts relate to perceptions of the aesthetics of towers, or fears over electromagnetic radiation. Economists and appraisers have studied this issue and use a statistical analysis methodology known as hedonic pricing, or hedonic modelling, to assess how different attributes of properties such as distance from a tower affect property value (Bond, Sims, & Dent, 2013). Essentially, analysts compare the value of multiple properties while statistically controlling for differences in property attributes, in order to isolate the effect of a specific attribute such as proximity of a communications tower.

A recent literature review examined such studies in the United States, Germany, and New Zealand (Bond, Sims, & Dent, 2013). These studies all focused on residential properties. One study identified a positive effect on price in one neighborhood due to the presence of a wireless communications tower. Most studies identified negative effects on price. Generally, these negative effects were small: an approximately two percent decrease in property price. In one case, the average reduction in price was 15 percent. In all cases, the effects declined rapidly with distance, with some cases showing no effect beyond 100 meters (328 feet) and one case showing effects up to about 300 meters (984 feet).

Based on review of the particulars of each study, the literature review authors hypothesize that many additional factors regarding communications towers, besides distance, may affect property value. These include the type, height, size, and appearance of communication towers; grouping of towers; the level of activity in the property market at the time properties are listed or sold; and the level of negative local media focus on potential health effects of communication towers at the time properties are listed or sold.

Economic Benefits or Adverse Impacts Related to changes in Spending, Income, Industries, and Public Revenues

Developing the NPSBN may increase economic activity as governments and contractors make expenditures to deploy, operate, and maintain telecommunications and broadband infrastructure. Funds for such expenditures would come primarily from federal, state, and local government sources or through private entities under a written agreement with such governmental entities. FirstNet has three primary sources of funding to carry out its mission: (1) up to $7 billion in cash funded by proceeds of incentive auctions authorized by the Act; (2) network user or subscriber fees; and (3) fees from covered leasing agreements that allow FirstNet to permit a secondary users to access network capacity on a secondary basis for non-public safety services only. The use of NPSBN capacity on a secondary basis for non-public safety services, including commercial services, by parties entering into a covered leasing agreement with FirstNet may also increase economic activity and generation of income for such party.

Direct spending of federal, state, and private sector funds to deploy and operate the NPSBN would likely represent new income to businesses that provide goods and services for the network, resulting in a positive impact. This direct impact would lead to indirect impacts (as directly impacted businesses purchase supporting goods and services) and induced impacts (as the employees of all affected businesses spend the wages they have earned). Because most FirstNet infrastructure investments would be dispersed across the nation, the business income and wages generated in any particular state or community would generally be small relative to the overall state or community economy, but measurable. Based on the significance criteria above, the business income and wage impacts would be considered positive and less than significant. 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. Bureau of the Census, 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 considerably across Colorado. The average unemployment rate in 2014 was 5.0 percent, considerably lower than the national rate of 6.2 percent. Counties with unemployment rates below the national average (that is, better employment performance) were distributed throughout most of the state. However, many of the counties in the south-central portion of the state had unemployment rates above the national average.

Large companies that win major contracts for deploying and operating the NPSBN may have concentrations of employees in some specific locations; for instance, engineers and other system designers may be located in one or a few specific offices. While such employment concentrations could be important to specific communities, these and other employment impacts would still not be significant based on the criteria in Table 3.2.9-1 because they would not constitute a "high level of job creation *at the state or territory level.*"

Changes in Population Number or Composition

In general, changes in population numbers occur when employment increases or decreases to a degree that affects the decisions of workers on where they can find employment; that is, when workers and their families move to or leave an area because of employment opportunities or the lack thereof. As noted above, deployment and operation of the NPSBN is likely to generate new employment opportunities (directly and indirectly), but employment changes would not be large enough in any state to be considered significant. Therefore, it is highly unlikely that the NPSBN would lead to significant changes in population numbers according to the significance criteria table above. Further, it is unlikely that the NPSBN would lead to any measurable changes in population numbers in any geographic areas, with the possible exception of cities where companies that win major NPSBN contracts establish centers for NPSBN deployment and operation activities. Smaller numbers of employees in any area would not produce measurable population changes because population is always in flux due to births, deaths, and in-migration and out-migration for other reasons.

Population composition refers to age, gender, race, ethnicity, and other characteristics of the individuals making up a population. Given the low potential for changes to population numbers, it is highly unlikely that the NPSBN would lead to any changes in population composition.

3.2.9.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Almost all deployment activities would have socioeconomic impacts, because all represent economic activity that would result, for instance, in expenditures and generation of income. These effects are measurable by economists, even if very small, but their significance is determined by application of the criteria in Table 3.2.9-1.

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 or near bodies of water, and associated onshore activities at existing or new facilities would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment through existing or new boxes or huts would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
  - New Build – Aerial Fiber Optic Plant: Pole/structure installation would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.

        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
- Wireless Projects
    - New Wireless Communication Towers: Installation of new wireless towers and associated structures, such as generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads, or access roads would have the following types of socioeconomic impacts:
        - Impacts to Real Estate – As discussed above, communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). Such impacts, if they occur, would be limited to a small area around each project and would generally be a small percentage reduction in property value; thus the impacts would be less than significant.
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would include mounting or installing equipment (such as antennas) on an existing facility would have the following types of socioeconomic impacts. While communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013), the impacts of existing wireless towers are presumably already factored into property values and would not be affected by the addition of new equipment.
        - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
        - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.
    - Deployable Technologies: COWs, COLTs, and SOWs and aerial deployable technologies require storage, staging, and (for aerial deployables) launch/landing areas. Development of such areas, or enlargement of existing areas to accommodate FirstNet equipment, would have the following types of socioeconomic impacts:
        - Impacts to Real Estate – It is possible that development or enlargement of storage, staging, and launch/landing areas could have adverse impacts on nearby property values. This is because such facilities may have adverse aesthetic aspects (e.g., parked vehicles in new parking lots), equipment maintenance activities at such facilities may generate noise, and operational activities may generate traffic. Such factors could affect nearby property values. These impacts, if they occur, would occur within a limited distance of each site, and would be limited to a relatively small

number of sites within the region and state. Therefore, these impacts would be less than significant.

    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would be similar to collocation of wireless equipment on existing wireless towers, structures, or buildings, and would have the following types of socioeconomic impacts:
    - Changes to Spending, Income, Industries, and Public Revenues – Materials and labor for these projects would represent new expenditures that would generate income, help support industries, and may generate public revenues. All such effects would be small in scale relative to the regional and state economy and of limited duration; their impacts would be less than significant.
    - Impacts to Employment – Similarly, expenditures for these projects would generate temporarily a less than significant number of jobs regionally and statewide.

In general, the abovementioned activities would have less than significant beneficial socioeconomic impacts. To the extent that certain activities could have adverse impacts to property values, those impacts are also expected to be less than significant, as described above. Chapter 19, 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.

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.

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 the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.9.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to socioeconomics resulting from implementation of this alternative could be as described below.

Deployment Impacts

As explained above, all deployment activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, such as generation of business income and employee wages, and creation or sustainment of jobs. The impacts would be small for each activity, and therefore less than significant.

Deployable technologies such as COWs, COLTs, and SOWs, along with aerial deployable technologies, would require storage, staging, and launch/landing areas. Development or enlargement of these facilities could have adverse impacts on nearby property values. The potential for such impacts is higher under this alternative than the Preferred Alternative because it is likely that these facilities would be implemented in greater numbers and over a larger geographic extent. The potential adverse impacts of new wireless communication towers on property values would be avoided under the Deployable Technologies Alternative. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

All operational activities represent economic activity and thus have socioeconomic impacts. These impacts would primarily be beneficial, and because they are small individually, overall impacts would be less than significant.

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 site within the state. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated deployment or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to socioeconomics from deployment and operation of the No Action Alternative. Socioeconomic conditions would therefore be the same as those described in Section 3.1.9, Socioeconomics.

3.2.10. Environmental Justice

3.2.10.1. Introduction

This section describes potential impacts to environmental justice in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.10.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on environmental justice were evaluated using the significance criteria presented in Table 3.2.10-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to environmental justice addressed in this section are presented as a range of possible impacts.

Table 3.2.10-1: Impact Significance Rating Criteria for Environmental Justice

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Effects associated with other resource areas (e. g., human health and safety, cultural resources, socioeconomics) that have a disproportionately high and adverse impact on low-income populations and minority populations	Magnitude or Intensity	Direct and disproportionately high and adverse effects on environmental justice communities (as defined by EO 12898) that cannot be fully mitigated.	Effect that is potentially significant, but with mitigation is less than significant.	Direct effects on environmental justice communities (as defined by EO 12898) that are not disproportionately high and adverse, and therefore do not require mitigation.	No direct effects on environmental justice communities, as defined by EO 12898.
	Geographic Extent	Effects realized within counties at the Census Block Group level.		Effects realized within counties at the Census Block Group level.	Effects realized within counties at the Census Block Group level.
	Duration or Frequency	Persists during the life of the project.		Persists for as long as the entire construction phase or a portion of the operations phase.	NA

NA = Not Applicable

3.2.10.3. Description of Environmental Concerns

Effects Associated with Other Resource Areas that have a Disproportionately High and Adverse Impact on Low-Income Populations and Minority Populations

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Office of the President, 1994), and guidance from CEQ, require federal agencies to evaluate potential human health and environmental effects on environmental justice populations. Specifically, "Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelated to impacts on the natural or physical environment." (CEQ, 1997) Thus, effects associated with other resource areas are of interest from an environmental justice perspective. This includes Human Health and Safety, Cultural Resources, Socioeconomics, Noise, Aesthetics and Visual Resources, and other resources.

Potential concerns noted in the impact analyses for these resources include dust, noise, traffic, and other adverse impacts of construction activities. New wireless communication towers sometimes have adverse impacts on nearby property values (Bond, Sims, & Dent, 2013). (See Socioeconomics Environmental Consequences for additional discussion.) The presence and operation of large storage, staging, and launch/landing areas for deployable technologies could raise environmental justice concerns as described below. Indian tribes are considered environmental justice populations (CEQ, 1997); thus, impacts on tribal cultural resources (for instance, due to construction) could be a concern from an environmental justice perspective.

Impacts are considered environmental justice impacts only if they are *both* "adverse" and "disproportionately high" in their incidence on environmental justice populations relative to the general population (CEQ, 1997). The focus in environmental justice impact assessments is always, by definition, on adverse effects. However, telecommunications projects, such as those proposed by FirstNet, could have beneficial effects. These effects may include better provision of police, fire, and emergency medical services; improvements in property values; and the generation of jobs and income. These impacts are considered in the Socioeconomics Environmental Consequences (Section 3.2.9).

Construction impacts are localized, and property value impacts of wireless telecommunications projects rarely extend beyond 300 meters (984 feet) of a communications tower (Bond, Sims, & Dent, 2013). In addition, impacts related to deployment are of short duration. The potential for significant environmental justice impacts from the FirstNet deployment activities would be limited. Most, but not all, of the FirstNet operational activities have very limited potential for impacts as these activities are limited in scale and short in their duration.

Before FirstNet deploys projects, additional site-specific analyses to identify specific environmental justice populations and assess specific impacts on those populations may be necessary. Such analyses could tier-off the methodology and results of this PEIS. The areas shown in the environmental justice screening map of Affected Environment (Section 3.1.10) as having moderate potential or high potential for environmental justice populations would particularly warrant further screening. As discussed in Section 3.1.10.3, Environmental Setting:

Minority and Low-Income Populations, Colorado has higher percentages of Hispanic and All Minorities populations than the region. Compared to the nation, the state's Hispanic population percentage is somewhat higher, and its All Minorities population percentage is lower. Colorado has a lower poverty rate than the region or nation. Colorado 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. The distribution of areas with moderate potential for environmental justice populations is also fairly even across the state. One notable pattern of distribution is that nearly all block groups in the southeastern part of the state are categorized as high or moderate potential for environmental justice populations; there are very few low potential areas in this part of Colorado. Further analysis using the data developed for the screening analysis in Section 3.1.10.4, 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, 2015m; USEPA, 2014c).

A site-specific analysis would also evaluate whether an actual environmental justice impact on those populations would be likely to occur. Analysts could use the evaluation presented below under "Activities with the Potential to Have Impacts" as a starting point. Analysts should bear in mind that any such activities that are problematic based on the adverse impact criterion of environmental justice may also have beneficial impacts on those same environmental justice communities.

3.2.10.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could deploy various types of facilities or infrastructure. Depending on the physical nature and location of FirstNet facilities or infrastructure and the specific action, some activities would result in potential impacts to environmental justice communities and others would not. In addition, and as explained in this section, the same type of proposed action infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

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 to environmental justice. If physical access is required to light dark fiber, it would likely be through existing hand holes, pulling vaults, junction boxes, huts, and similar existing structures, with no resulting impacts on environmental justice communities.
- Satellites and Other Technologies
    - Satellite-Enabled Devices and Equipment: It is anticipated that the deployment of such devices and equipment would not involve 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 communities, it is anticipated that this activity would have no impact on environmental justice issues.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to environmental justice for the Preferred Alternative would encompass a range of impacts that could occur as a result of disturbance to communities from construction activities, such as noise, dust, and traffic. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to environmental justice communities include the following:

- Wired Projects
    - New Build – Buried Fiber Optic Plant: New fiber optic cable installation usually requires construction activities such as trenching, plowing (including vibratory plowing), or directional boring, as well as construction of hand holes, pulling vaults, junction boxes, huts, and POP structures. These activities could temporarily generate noise and dust, or disrupt traffic. If such impacts occur disproportionately to environmental justice communities, they would be considered environmental justice impacts.
    - New Build – Aerial Fiber Optic Plant: Pole/structure installation could temporarily generate noise and dust, or disrupt traffic. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts.
    - New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of

water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
    - Installation of Optical Transmission or Centralized Transmission Equipment: 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. Chapter 19, BMPs and

Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of primarily of routine maintenance and inspection of fixed infrastructure. It is anticipated that such activities would not result in environmental justice impacts, as the intensity of these activities would be low (low potential for objectionable effects such as noise and dust) and their duration would be very short. Routine maintenance and inspection would not adversely affect property values, for the same reasons. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment activities that involve construction. Impacts are expected to be less than significant. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.10.5. 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

The ongoing presence of facilities for housing and maintaining deployable technologies may have adverse aesthetic aspects (e.g., large areas of pavement and large numbers of parked vehicles) that could negatively affect the value of surrounding properties. In addition, equipment maintenance activities at such facilities may temporarily generate noise, and operational activities may generate traffic. These effects may be adverse in themselves, and may impact property values. If these effects occur disproportionately in environmental justice communities, they would be considered environmental justice impacts. Impacts are expected to be less than significant as operation are expected to be temporary in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed. Therefore, there would be no associated construction or installation activities to deploy wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to environmental justice as a result of deployment and operation of the No Action Alternative. Environmental conditions would therefore be the same as those described in Section 3.1.10, Environmental Justice.

3.2.11. Cultural Resources

3.2.11.1. Introduction

This section describes potential impacts to cultural resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.11.2. Impact Assessment Methodology and Significance Criteria

The potential impacts of the Proposed Action on cultural resources were evaluated using the significance criteria presented in Table 3.2.11-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to cultural resources addressed in this section are presented as a range of possible impacts.

Table 3.2.11-1: Impact Significance Rating Criteria for Cultural Resources

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect**[161]	**Effect, but Not Adverse**	**No Effect**
Physical damage to and/or destruction of historic properties[162]	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	No indirect effects to historic properties.

[161] Whereas mitigation measures for other resources discussed in this PEIS may be developed to achieve an impact that is "Less than Significant with Mitigation Incorporated," historic properties are considered to be "non-renewable resources," given their very nature. As such, any and all unavoidable adverse effects to historic properties, per Section 106 of the NHPA (as codified in 36 CFR Part 800.6), would require FirstNet to consult with the SHPO/THPO and other consulting parties, including Indian tribes and Native Hawaiian Organizations, to develop appropriate mitigation.

[162] Per NHPA, a "historic property" is defined as any district, archaeological site, building, structure, or object that is either listed or eligible for listing in the NRHP. Cultural resources present within a project's APE are not historic properties if they do not meet the eligibility requirements for listing in the NRHP. Sites of religious and/or cultural significance refer to areas of concern to Indian tTribes 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.

Type of Effect	Effect Characteristics	Impact Level			
		Adverse Effect	**Mitigated Adverse Effect** [161]	**Effect, but Not Adverse**	**No Effect**
				many 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.
	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.

3.2.11.3. Description of Environmental Concerns

Physical Damage to and/or Destruction of Historic Properties

One of the primary environmental concerns during deployment activities is damage to or destruction of historic and cultural resources. Deployment involving ground disturbance has the potential to damage or destroy archaeological sites, and the attachment of communications equipment to historic building and structures has the potential to cause damage to features that are historically significant.

Based on the impact significance criteria presented in Table 3.2.11-1, direct deployment impacts could be potentially significant if FirstNet's deployment locations were in areas with moderate to high probabilities for archaeological deposits, within historic districts, or at historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas with archaeological deposits or within historic districts. However, given archaeological sites and historic properties are present throughout Colorado, some deployment activities may be in these areas, in which case BMPs (see Chapter 19) would help avoid or minimize the potential impacts.

Indirect Effects to Historic Properties (i.e., visual, noise, vibration, atmospheric)

The potential for indirect effects to historic properties would be present during deployment of the proposed facilities/infrastructure and during trenching, grading, and/or foundation excavation activities. Indirect effects include the introduction of visual, noise, atmospheric, and/or vibration effects that diminish a property's historic integrity. The greatest likelihood of potentially significant impacts from indirect effects would be from the deployment of equipment in areas that would cause adverse visual effects to historic properties. To the extent practicable, FirstNet would attempt to minimize activities in areas within or adjacent to historic districts or properties.

Loss of Character Defining Attributes of Historic Properties

Deployment of FirstNet equipment has the potential to cause the loss of character defining attributes of historic properties; such attributes are the features of historic properties that define their NRHP eligibility. Examples of such impacts would be the loss of integrity of archaeological sites through ground disturbing activities, and direct impacts to historic buildings from equipment deployment that adversely alter historic architectural features. Significant impacts such as these could be avoided or minimized through BMPs (see Chapter 19).

Loss of Access to Historic Properties

The deployment of equipment requiring a secure area has the potential to cause the loss of access to historic properties. The highest potential for this type of significant impact would be from the deployment of equipment in secure areas that impact the access to sites of cultural importance to American Indians. It is anticipated that FirstNet would identify potential impacts to such areas by conducting research on particular areas and through the NHPA consultation process, and would minimize deployment activities that would cause such loss of access.

3.2.11.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, 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 cultural resources, while others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to cultural resources under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. It is anticipated that there would be no impacts to cultural resources since the activities that would be conducted at these small entry and exit points are not likely to produce impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up of dark fiber would have no impacts to cultural. If required, and if done in existing huts with no ground disturbance, installation of new associated equipment would also have no impacts to cultural resources because there would be no ground disturbance and no perceptible visual changes.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: It is anticipated that the installation of permanent equipment on existing structures and the use of portable devices that use satellite technology would not impact cultural resources because those activities would not require ground disturbance or create perceptible visual effects.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact cultural resources, it is anticipated that this activity would have no impact on cultural resources.

Activities with the Potential to Have Impacts

Potential deployment-related impacts to cultural resources as a result of implementation of the Preferred Alternative would encompass a range of impacts that could occur as a result of ground disturbance activities, including destruction of cultural or historic artifacts. The types of infrastructure deployment activities that could be part of the Preferred Alternative and result in potential impacts to cultural resources include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POP, huts, or other associated facilities or hand-holes to access fiber could result in potential impacts to cultural resources. Soil disturbance and heavy equipment use associated with plowing, trenching, or directional boring as well as land/vegetation clearing, excavation activities, and landscape grading associated with construction of POPs, huts, or other associated facilities or hand-holes to access fiber could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties.
  - New Build – Aerial Fiber Optic Plant: Ground disturbance during the installation of new utility poles and the use of heavy equipment during the installation of new utility poles and hanging of cables could result in the disturbance of archaeological sites, and the associated structures could have visual effects on historic properties and structures within the state.
  - New Build – Submarine Fiber Optic Plant: The installation of cables in limited nearshore and inland bodies of water could impact cultural resources, as shorelines and creekbanks in Colorado have the potential to contain prehistoric archaeological sites (archaeological deposits tend to be associated with bodies of water and have high probabilities for archaeological deposits). Impacts to cultural resources could also potentially occur as a result of the construction of landings and/or facilities on shore to accept submarine cable, which could result in the disturbance of archaeological and historical sites, and the associated network structures could have visual effects on historic properties.
  - Installation of Optical Transmission or Centralized Transmission Equipment: If installation of transmission equipment would occur in existing boxes or huts and require no ground disturbance, there would be no impacts to cultural resources. If installation of transmission equipment required grading or other ground disturbance to install small boxes or huts, or access roads could potentially impact cultural resources. Ground disturbance could impact archaeological sites, and the associated structures could have visual effects on historic properties.
  - Collocation on Existing Aerial Fiber Optic Plant: Soil excavation and excavated material placement during the replacement of poles and structural hardening could result in direct and indirect effects to cultural resources, although any effects to access would be short-term. Heavy equipment use associated with these activities as well as with installing new fiber on existing poles could result in direct and indirect effects to cultural resources.
- Wireless Projects
  - New Wireless Communication Towers: Deployment of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in impacts to historic properties. Land/vegetation clearing, excavation activities,

landscape grading, and other ground disturbance activities during the deployment of new wireless towers and associated structures or access roads, could result in the disturbance of archaeological sites. The deployment of new wireless communication towers and their associated structures could result in visual impacts to historic properties or the loss of access to historic properties.

- Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on an existing tower could result in impacts to historic properties. Ground disturbance activities could result in impacts to archaeological sites, and the deployment of collocated equipment could result in visual impacts or physical damage to historic properties, especially in urban areas that have larger numbers of historic buildings.
- Deployable Technologies: Implementation of deployable technologies could result in potential impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. In addition, impacts to historic properties could occur if the deployment is long-term, or if the deployment involves aerial technologies with the potential for visual or other indirect impacts.

In general, the abovementioned activities could potentially involve ground disturbance, construction of access roads and other impervious surfaces, landscape grading, and heavy equipment movement. Potential impacts to cultural resources associated with deployment could include physical damage to or destruction of historic properties, indirect impacts including visual effects, the loss of access to historic properties, or the loss of character-defining features of historic properties. These 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be no effect to cultural resources associated with routine inspections of the Preferred Alternative. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors, or if the acceptable load of the surface is exceeded, ground disturbance impacts on archaeological sites could result as explained above. These potential impacts would be associated with ground disturbance or modifications of properties, however, due to the small scale of expected activities, these actions could effect but would not likely adversely effect, 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.11.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to cultural resources as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in impacts to cultural resources if deployment occurs in unpaved areas, or if the implementation results in paving of previously unpaved surfaces. Some staging or landing areas (depending on the type of technology) may require land/vegetation clearing, excavation, and paving. These activities could result in impacts to archaeological sites. These activities could affect, but not adversely affect, cultural resources due to the limited amount of expected ground disturbing activities and the short-term nature of deployment activities. However, in the event that land/vegetation clearing is required, FirstNet would engage in consultation as required under Section 106 of the NHPA. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the deployment impacts, it is anticipated that there would be effects, but no adverse 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to cultural resources as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.11, Cultural Resources.

3.2.12. Air Quality

3.2.12.1. Introduction

This section describes potential impacts to Colorado's air quality from deployment and operation of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.12.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on Colorado's air quality were evaluated using the significance criteria presented in Table 3.2.12-1. As described in Section 3.2, Environmental Consequences, the categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to Colorado's air quality addressed in this section are presented as a range of possible impacts.

Table 3.2.12-1: Impact Significance Rating Criteria for Colorado

Type of Effect	Effect Characteristics	Impact Level: Potentially Significant	Impact Level: Less than Significant with BMPs and Mitigation Measures Incorporated	Impact Level: Less than Significant	Impact Level: No Impact
Increased air emissions	Magnitude or Intensity	Pollutant concentrations would exceed one or more NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would cause an area to be out of attainment for any NAAQS. Projects do not conform to the SIP covering nonattainment and maintenance areas.	Effect that is potentially significant, but with mitigation is less than significant.	Negligible emissions would occur for any criteria pollutants within an attainment area but would not cause a NAAQS exceedance.	Action would not cause pollutant concentrations to exceed the NAAQS in nonattainment and maintenance areas. Emissions in attainment areas would not cause air quality to go out of attainment for any NAAQS. Projects are *de minimis* or conform to the SIP covering nonattainment and maintenance areas.
	Geographic Extent/Context	NA		NA	NA
	Duration or Frequency	Permanent or long-term.		Short-term.	Temporary.

NA = Not Applicable

3.2.12.3. Description of Environmental Concerns

Increased Air Emissions

The Proposed Action has the potential to generate air pollutant emissions. These emissions could be above and beyond what is typically generated in a given area and may alter ambient air quality. Deployment activities may involve the use of vehicles, heavy equipment, and other equipment that could emit exhaust and create fugitive dust in localized areas. During operations, routine maintenance and other use of generators at tower facilities may emit exhaust for specific durations (maintenance) or unpredictable timeframes (if power is lost to a site, for example). Impacts are likely to be less than significant due to the mobile nature of the sources and the temporary and short-term duration of deployment activities. Although unlikely, the emissions of criteria pollutants could impair the air quality of the region and potentially affect human health. Potential impacts to air quality from emissions may occur in areas where the current air quality exceeds, or has a history of exceeding, one or more NAAQS. Areas exist in Colorado that are in maintenance or nonattainment for one or more criteria pollutants (see Section 3.1.12, Air Quality and Figure 3.1.12-1). Several counties in Colorado are designated as nonattainment or maintenance areas for one or more of the following pollutants: CO, PM, and ozone (Table 3.1.12-5); counties located in the north-central portion of the state are designated nonattainment or maintenance for two or three NAAQS pollutants (Figure 3.1.12-1).

Based on the significance criteria presented in Table 3.2.12-1, 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 Colorado; however, NAAQS exceedances are not anticipated. Given that nonattainment areas are present throughout Colorado (Figure 3.1.12-1), FirstNet would try to minimize potential emissions where possible and would recommend the implementation of BMPs, where feasible and practicable, to avoid or minimize potential impacts.

3.2.12.4. Potential Impacts of the Preferred Alternative

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

Deployment and Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to air quality and others would not. The potential impacts could range from no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no impacts to air quality under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Activities associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit. Gaining access to the conduit and installing the cable may result in minor disturbance at entry and exit points; however, this activity would be temporary and infrequent, and is not expected to produce any perceptible changes in air emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions to air quality because it would create no new sources of emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant concentrations of criteria pollutants would be emitted during installment of this equipment from the use of machinery. Deployment and operation of satellite-enabled devices and portable equipment are expected to have minimal to no impact on ambient air quality concentrations.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact air quality resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential to Impact Air Quality

Construction, deployment, and operation activities related to the Preferred Alternative could impact air quality by generating various quantities of criteria and air pollutant emissions. It is expected that such impacts would be less than significant due to the shorter duration and localized nature of the activities. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in fugitive dust and products of combustion from the use of vehicles and heavy equipment.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other

associated facilities to house plant equipment could result in products of combustion from the use of vehicles and machinery, as well as fugitive dust emissions from site preparation.

- Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during pole replacement, and other heavy equipment used for structural hardening or reinforcement, could result in products of combustion from the use of vehicles and heavy equipment, as well as fugitive dust from site preparation.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
- Installation of Optical Transmission or Centralized Transmission Equipment: Emissions associated with the installation of optical transmission or centralized transmission equipment would be limited to the short-term, temporary use of vehicle and construction equipment. Long-term impacts are unlikely, as the power requirements for optical networks are relatively low.

- Wireless Projects
    - New Wireless Communication Towers: Activities associated with installing new wireless towers and associated structures (e.g., generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in products of combustion. Operating vehicles and other heavy equipment, running generators while conducing excavation activities and landscape grading to install new wireless towers and associated structures or access roads could result in products of combustion and fugitive dust.
    - Collocation on Existing Wireless Tower, Structure, or Building: Vehicles and equipment used to mount or install equipment, such as antennas or microwave dishes, on an existing tower could impact air quality. However, if the 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major communications infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned deployment impacts. It is anticipated that there would be less than significant impacts to air quality associated with routine inspections of the Preferred Alternative due to the limited nature of the activity. If usage of heavy equipment as part of routine maintenance or inspections occurs off established access roads or corridors additional air quality impacts may occur, however, they would be less than significant as they would still be limited in nature. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.12.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative could include heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and other equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations, and the duration of deployment. The potential impacts to air quality are as follows:

Deployment and Operation Impacts to Air Quality

Implementing deployable technologies could result in products of combustion from mobile equipment deployed via heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a greater cumulative impact, although this is expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term. These vehicles may also produce fugitive dust if traveling on unpaved roads. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could emit products of combustion as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. The products of combustion from ground support vehicles, as well as the duration of ground support operations and travel between storage and deployment locations would dictate the concentrations and associated impacts. Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient air quality. By not deploying NPSBN, FirstNet would avoid generating emissions from construction, installation, or operation of wired, wireless, or deployable infrastructure or technologies; satellites; and other technologies.

3.2.13. Noise

3.2.13.1. Introduction

This section describes potential noise impacts from construction, deployment, and operation of the Proposed Action and Alternatives in Colorado. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.13.2. Impact Assessment Methodology and Significance Criteria

The noise impacts of the Proposed Action were evaluated using the significance criteria presented in Table 3.2.13-1. 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 Colorado addressed in this section are presented as a range of possible impacts.

Table 3.2.13-1: Impact Significance Rating Criteria for Noise

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	**Less than Significant with BMPs and Mitigation Measures Incorporated**	**Less than Significant**	**No Impact**
Increased noise levels	Magnitude or Intensity	Noise levels would exceed typical noise levels from construction equipment and generators. Noise levels at noise sensitive receptors (such as residences, hotels/motels/inns, hospitals, and recreational areas) would exceed 55 dBA or specific state noise limits. Noise levels plus baseline noise levels would exceeds 10 dBA increase from baseline noise levels (i.e., louder). Project noise levels near noise receptors at National Parks would exceed 65 dBA.	Effect that is potentially significant, but with mitigation is less than significant.	Noise levels resulting from project activities would exceed natural sounds, but would not exceed typical noise levels from construction equipment or generators.	Natural sounds would prevail. Noise generated by the action (whether it be construction or operation) would be infrequent or absent, mostly immeasurable.
	Geographic Extent/Context	County or local.		County or local.	County or local.
	Duration or Frequency	Permanent or long-term.		Short-term.	Temporary.

3.2.13.3. Description of Environmental Concerns

Increased Noise Levels

The Proposed Action has the potential to generate noise during construction and operation of various equipment used for deployment. These noise levels could be above what is typically generated in a given area and may alter the ambient acoustical environment. If significant, the noise could cause impacts on residential areas, or other facilities that are sensitive to noise, such as churches, hospitals, or schools. The construction activities for deploying some of the various equipment evaluated under the Proposed Action could cause short-term impacts to nearby populations. However, it is likely that there would be less long-term effects from operational use of the proposed equipment (see Section 3.1.13, Noise).

Based on the significance criteria presented in Table 3.2.13-1, noise impacts would likely be less than significant given the size and nature of the majority of the proposed deployment activities. The majority of FirstNet's deployment activities would not be located in sensitive areas nor would a large number of noise sources be deployed/operated long-term in the same area. Noise levels from deployment activities are not expected to exceed typical noise levels for short-term/temporary construction equipment or generators.

To the extent practicable, FirstNet would attempt to mitigate or minimize noise effects during construction or operation. BMPs and mitigation measures could help to limit impacts on nearby noise-sensitive receptors. However, given that much of the concentration and setup of equipment would often occur in populated areas, FirstNet operations would not be able to completely avoid noise impacts due to construction and operations at various receptors.

3.2.13.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementing the Preferred Alternative could result in deploying various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential noise impacts and while others would not.

In addition, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant impacts depending on the deployment scenario or site-specific conditions.

Activities Likely to Have No Impacts

Of the types of facilities or infrastructure deployment scenarios described in Section 2.1.2, Proposed Action Infrastructure, the following are likely to have no noise impacts under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: Disturbance associated with the installation of fiber optic cable in existing conduit would be limited to entry and exit points of the existing conduit in previously disturbed areas. Noise generated by equipment required to install fiber would be infrequent and of short duration, and is not expected to create perceptible impacts.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction or installation activities, and therefore would have no noise impacts.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The duration of construction activities associated with installing permanent equipment on existing structures would most likely be short-term. It is anticipated that insignificant levels of noise would be emitted during installment of this equipment. Noise caused by these construction and installation activities would be similar to other construction activities in the area, such as the installation of cell phone towers or other communication equipment. Deployment and operation of satellite-enabled devices and equipment are expected to have minimal to no impact on the noise environment.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the deployment of the NPSBN; however, it may include equipment on satellites that are already being launched for other purposes. As adding equipment to an existing launch vehicle would be very unlikely to impact noise resources, it is anticipated that this activity would have no impact on those resources.

Activities with the Potential for Noise Impacts

Construction, deployment, and operation activities related to the Preferred Alternative could create noise impacts from either the construction or operation of the infrastructure. The types of infrastructure deployment scenarios or deployment activities that could be part of the Preferred Alternative and result in potential impacts to air quality include the following:

- Wired Projects
  - New Build – Buried Fiber Optic Plant: Plowing (including vibratory plowing), trenching, or directional boring and the construction of POPs, huts, or other associated facilities or hand-holes to access fiber as well as land/vegetation clearing, excavation activities, and landscape grading could result in high noise levels from the use of heavy equipment and machinery.
  - New Build – Aerial Fiber Optic Plant: The use of heavy equipment during the installation of new poles and hanging cables, as well as constructing access roads, POP huts, or other associated facilities to house plant equipment would be short-term and could result in increased noise levels from the use of vehicles and machinery.
  - Collocation on Existing Aerial Fiber Optic Plant: Excavation equipment used during potential pole replacement, and other heavy equipment used for structural hardening or

reinforcement, could result in temporary 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 or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
  - Installation of Optical Transmission or Centralized Transmission Equipment: 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. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the construction impacts. These impacts are expected to be less than significant 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that

FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Preferred Alternative would be less than significant and for 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.13.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific equipment associated with the Deployable Technologies Alternative would be heavy trucks with onboard generators, aerial vehicles (e.g., UASs or other aircraft), and ground support vehicles and equipment for aerial deployment. The stand-alone Deployable Technologies Alternative differs from the Preferred Alterative in the number of mobile and aerial vehicles likely to deploy, the distances traveled from storage locations and the duration of deployment. The potential noise impacts are as follows:

Deployment Noise 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

Operation activities associated with the Deployable Technologies Alternative would be similar to several of the deployment activities related to routine maintenance and inspection of the facilities. Operation of generators could also generate noise in the area. However, deployable technologies could be deployed to areas with few existing facilities, so noise impacts would 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, FirstNet would not deploy the NPSBN and there would be no impact to ambient noise. By not deploying the NPSBN, FirstNet would avoid generating noise from construction, installation, or operation of wired, wireless, deployable infrastructure or satellites and other technologies.

3.2.14. Climate Change

3.2.14.1. Introduction

This section describes potential impacts to climate and climate change-vulnerable resources in Colorado associated with deployment and operation of the Proposed Action and Alternatives. See Chapter 19, BMPs and Mitigation Measures, for a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.14.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on climate and potential climate change impacts on the Proposed Action's installations and infrastructure were evaluated using the significance criteria presented in Table 3.2.14-1. 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, 2015d), 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 3.2.14-1: Impact Significance Rating Criteria for Climate

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less Than Significant with Mitigation Measures Incorporated	Less Than Significant	No Impact
Contribution to climate change through GHG emissions	Magnitude or Intensity	Exceedance of 25,000 metric tons of CO_2e/year, and global level effects observed.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No increase in greenhouse gas emissions or related changes to the climate as a result of project activities.
	Geographic Extent	Global impacts observed.		Global impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA
Effect of climate change on FirstNet installations and infrastructure	Magnitude or Intensity	Climate change effects (such as sea level rise or temperature change) negatively impact FirstNet infrastructure.	Effect that is potentially significant, but with mitigation is less than significant.	Only slight change observed.	No measurable impact of climate change on FirstNet installations or infrastructure.
	Geographic Extent	Local and regional impacts observed.		Local and regional impacts observed.	NA
	Duration or Frequency	Long-term changes. Changes cannot be reversed in a short term.		Changes occur on a longer time scale. Changes cannot be reversed in the short term.	NA

NA = Not Applicable

3.2.14.3. Projected Future Climate

The Southwest is the hottest and driest region in the United States, and the region is already experiencing impacts of climate change. The decade 2001-2010 was the warmest in the 110-year instrumental historical record keeping, with temperatures almost 2 °F higher than historic averages, which included fewer cold air outbreaks and more heat waves. Summertime heat waves are projected to become longer and hotter, whereas the trend of decreasing wintertime cold air outbreaks is projected to continue. These changes will directly affect urban public health and will also have direct impacts on crop yields. (USGCRP, 2014a)

Air Temperature

Figures 3.2.14-1 and 3.2.14-2 illustrate the anticipated temperature changes for low and high GHG emission scenarios for Colorado from a 1969 to 1971 baseline.

Bsk – Figure 3.2.14-1 shows that by mid-century (2040 to 2059), temperatures in the entire state of Colorado under a low emissions scenario would increase by approximately 4 °F, and by the end of the century (2080 to 2099) under a low emissions scenario temperatures in the entire state of Colorado would increase by approximately 6° F. (USGCRP, 2009)

Figure 3.2.14-2 shows that under a high emissions scenario for the period (2040 to 2059), temperatures would increase by approximately 5 °F. Under a high emissions scenario for the period (2080 to 2099) in the Bsk region of Colorado, temperatures would increase by approximately 9° F in the northeastern portion and 10 °F in the remainder of the region. (USGCRP, 2009)

Dfb – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Bsk region under a low emissions scenario. (USGCRP, 2009)

Under a high emissions scenario during the mid-century emissions will increase at the same rate as the (Bsk) region while by the end of the century temperatures will increase by 10 °F in this region. (USGCRP, 2009)

Dfc – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfb region in both a low emission and high emissions scenario. (USGCRP, 2009)

Dsb – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfb and Dfc regions in both a low emission and high emissions scenario. (USGCRP, 2009)

Et – Temperatures in this region are expected to increase by mid-century (2040 to 2059) and by the end of the century (2080 to 2099) at the same rate as the Dfb, Dfc and Dsb regions in both a low emission and high emissions scenario. (USGCRP, 2009)

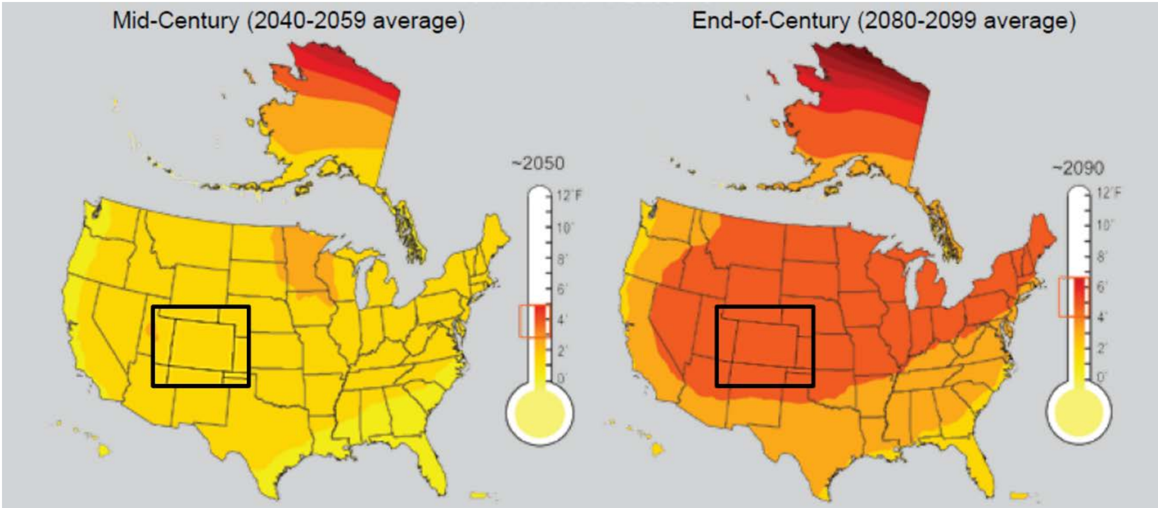

Figure 3.2.14-1: Colorado Low Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

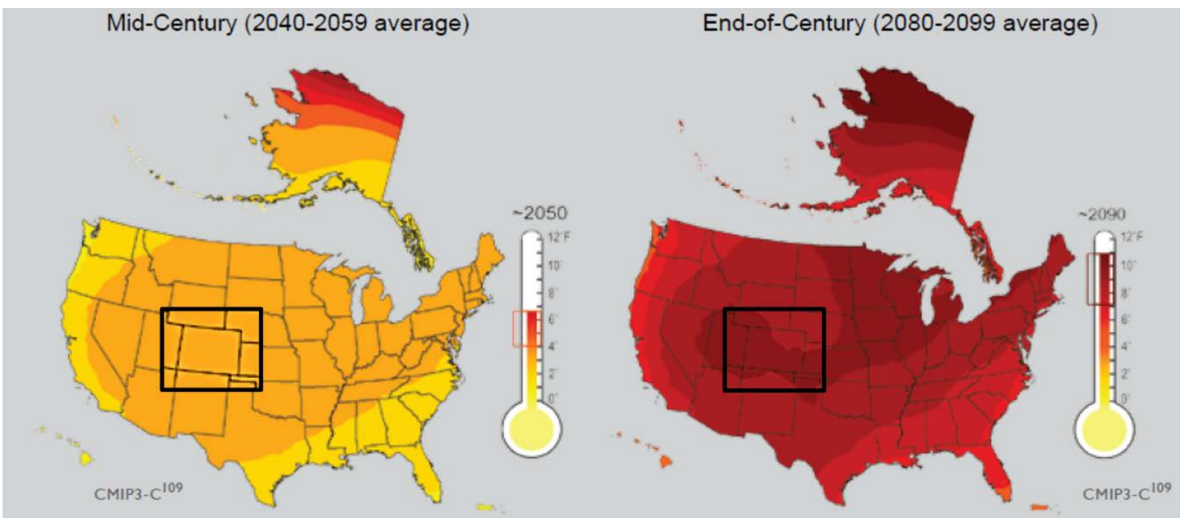

Figure 3.2.14-2: Colorado High Emission Scenario Projected Temperature Change

Source: (USGCRP, 2009)

Precipitation

Projections of precipitation changes are less certain than those for temperature. Under a high emissions scenario, reduced winter and spring precipitation is consistently projected for the southern part of the Southwest by 2100. In the northern part of the region, projected winter, spring, summer and fall precipitation changes are smaller than natural variations. The Southwest is prone to drought, and future droughts are projected to be substantially hotter, and for major river basins such as the Colorado River Basin, drought is projected to become more frequent, intense, and longer lasting. These drought conditions present a huge challenge for water resource management and natural hazards such as wildfire. (USGCRP, 2014a)

Total seasonal snowfall has generally decreased in southern and some western areas although snow is melting earlier in the year and more precipitation is falling as rain versus snow. Overall snow cover has decreased in the Northern Hemisphere, due in part to higher temperatures that shorten the time snow spends on the ground. (USGCRP, 2014b)

In Northern Colorado, there is an expected decrease in the number of consecutive dry days while in Southern Colorado, there is an expected increase in the number of consecutive dry days under a low emissions scenarios by mid-century (2041 to 2070) as compared to the period (1971 – 2000). In a high emissions scenario, all areas of Colorado would see an increase in the number of consecutive dry days. An increase in consecutive dry days could lead to drought. (USGCRP, 2014c)

Figures 3.2.14-3 and 3.2.14-4 show predicted seasonal precipitation change for an approximate 30-year period of 2071 to 2099 compared to a 1970 to 1999 approximate 30-year baseline. Figure 3.2.14-3 show seasonal changes in a low emissions scenario, which assumes rapid reductions in emissions where rapid reductions mean more than 70 percent cuts from current levels by 2050. (USGCRP, 2014c)

Figure 3.2.14-4 shows a high emissions scenario, which assumes continued increases in emissions, with associated large increases in warming and major precipitation changes. (Note: white areas in the figures indicate that the changes are not projected to be larger than could be expected from natural variability.) (USGCRP, 2014c)

Bsk – Figure 3.2.14-3 shows that in a low emissions scenario in the 30-year period for 2071 to 2099, precipitation would increase by 10 percent in winter and spring in portions of the Bsk region, and some portions of this region will not have any precipitation fluctuations in winter and spring. There are no expected increases in precipitation in summer and fall other than fluctuations due to natural variability. (USGCRP, 2014c)

Figure 3.2.14-4 shows that if emissions continue to increase, winter precipitation could increase 10, 20, and 30 percent over the period 2071 to 2099 depending on the portion of the region. In spring, precipitation in this scenario could increase as much as 10 percent in the north, and decrease 10 to 20 percent in the southwestern corner of the region. Some of the region in spring will experience no fluctuation in precipitation. Summer precipitation is projected to decrease 10 and 20 percent while some of the region has no projected changes in precipitation during summer. No significant change to fall precipitation is anticipated over the same period for the Bsk region. (USGCRP, 2014c)

Dfb – Under a low emissions scenario, precipitation in winter, spring, and summer are projected to increase by 10 percent in some of the region with no projected changes in precipitation in other portions of the region. There are no expected increases in precipitation in fall other than fluctuations due to natural variability in the Dfb region of Colorado. (USGCRP, 2009)

Under a high emissions scenario, winter precipitation is expected to increase 10, 20, or 30 percent depending on the portion of the region. In spring, precipitation is expected to increase 10 percent and decrease 10 percent depending on the portion of the region as shown in Figure 3.2.14-4. In summer, precipitation is expected to decrease 10 percent or show no variability depending on the portion of the region. No significant change to fall precipitation is anticipated in the Dfb region. (USGCRP, 2009)

Dfc **–** Under a rapid emissions reduction scenario in the Dfc region of Colorado, winter precipitation is expected to increase by 10 percent for part of the region while in other portions there are no expected changes. In spring, precipitation is expected to increase by 10 percent in this scenario. There are no projected changes to summer or fall precipitation in this scenario. (USGCRP, 2009)

Precipitation in winter under a high emissions scenario in the Dfc region will increase by 20 or 30 percent depending on the portion of the region. In spring, precipitation will decrease or increase by 10 percent depending on the portion of the region, and there may be no changes in precipitation in a very small portion of the Dfc region. There are no projected changes summer or fall precipitation in this scenario. (USGCRP, 2009)

Dsb **–** Under a low emissions scenario in winter, summer and fall there are no expected changes in precipitation. In a portion of the Dsb region, there are no expected changes to spring precipitation either. However, some of this region in spring could expect a 10 percent increase in precipitation. (USGCRP, 2009)

In a high emissions scenario, winter precipitation is projected to increase by 10 percent in the Dsb region of Colorado. In spring, precipitation is expected to decrease by 10 or 20 percent depending on the portion of the region. There are no anticipated changes in summer or fall precipitation in this scenario. (USGCRP, 2009)

Et **–** Under a low emissions scenario, in winter, spring and summer, there are no projected changes to precipitation in the Et region. In spring in this scenario, precipitation is expected to decrease by 10 percent. (USGCRP, 2009)

Precipitation is expected to increase by 20 percent under a high emissions scenario in the Et region of Colorado. In spring, precipitation is expected to decrease by 10 percent in this region. There are no projected changes to summer or fall precipitation under this scenario. (USGCRP, 2009)

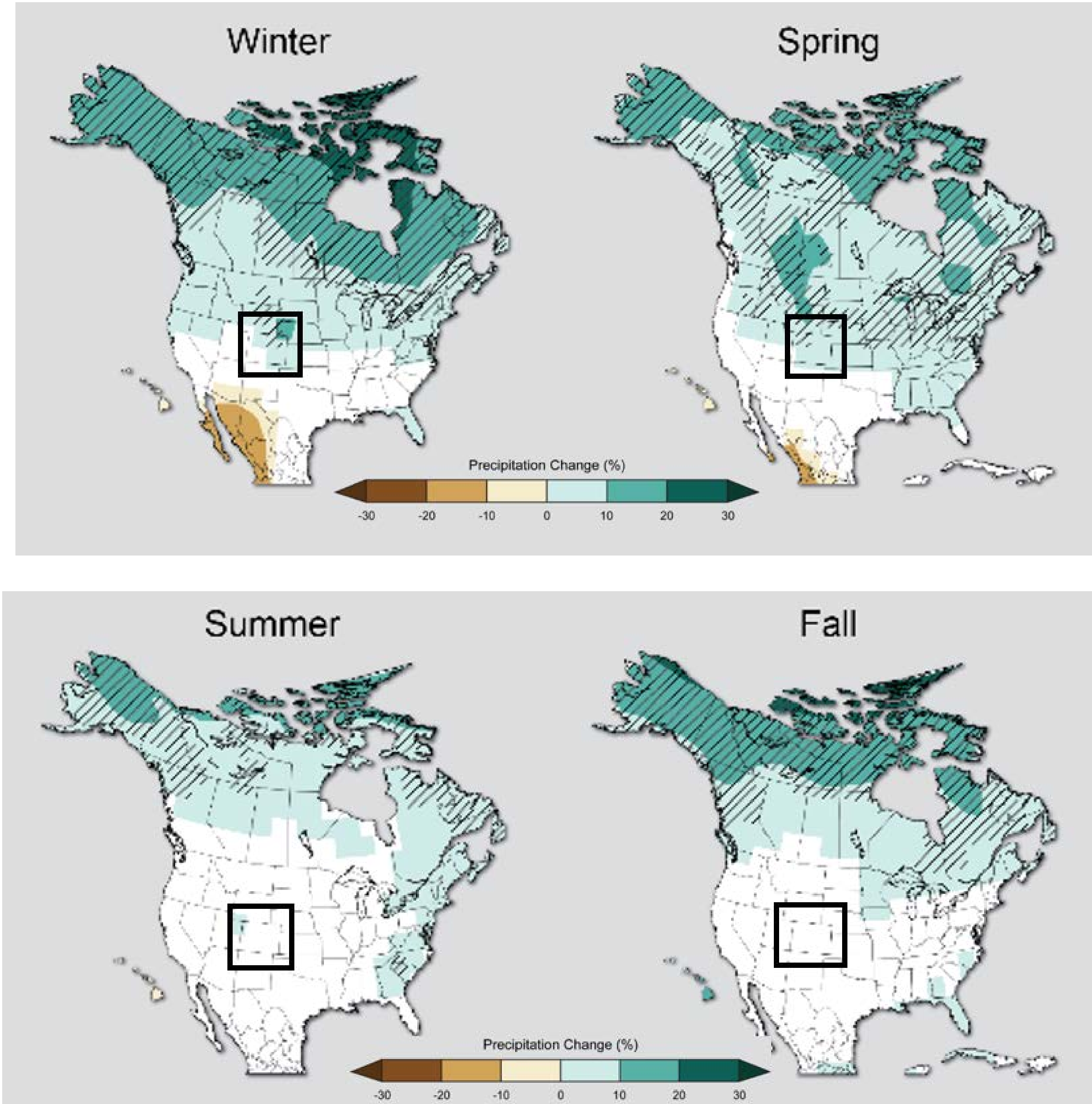

Figure 3.2.14-3: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a Low Emissions Scenario

Source: (USGCRP, 2014c)

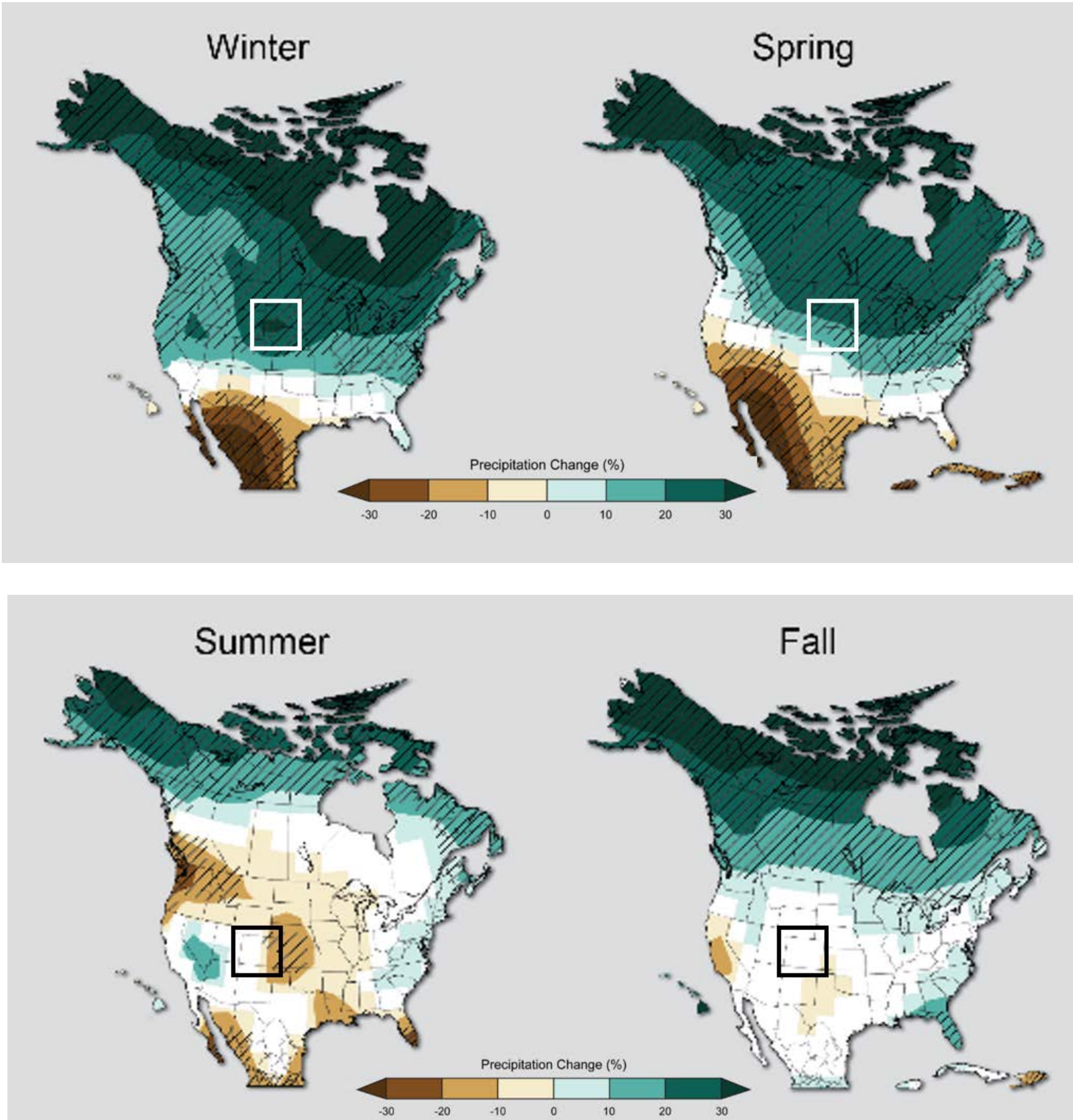

Figure 3.2.14-4: Predicted Seasonal Precipitation Change for 2071 to 2099 Compared to 1970 to 1999 Baseline in a High Emissions Scenario

Source: (USGCRP, 2014c)

Severe Weather Events

It is difficult to forecast the impact of climate change on severe weather events such as winter storms and thunderstorms. Trends in thunderstorms are subject to greater uncertainties than trends in temperature and associated variables directly related to temperature such as sea level rise. Climate scientists are studying the influences of climate change on severe storms. Recent research has yielded insights into the connections between warming and factors that cause severe storms. For example, atmospheric instability and increases in wind speed with altitude link warming with tornadoes and thunderstorms. Additionally, research has found a link between warming and conditions favorable for severe thunderstorms. However, more research is required to make definitive links between severe weather events and climate change. (USGCRP, 2014c)

3.2.14.4. Description of Environmental Concerns

Increases in GHG emissions have altered the global climate, leading to generalized temperature increases, weather disruption, increased droughts and heatwaves, and may have potentially catastrophic long-term consequences for the environment. Although GHGs are not yet regulated by the federal government, many states have set various objectives related to reducing GHG emissions, particularly CO_2 emissions from fossil fuels.

Based on the impact significance criteria presented in Table 3.2.14-1, climate change impacts as a result of GHG emissions could be significant and require a quantitative analysis if FirstNet's deployment of technology was responsible for increased emissions of 25,000 MT/year or more. The GHG emissions resulting from FirstNet activities fall into two categories: short-term and long-term. Short-term emissions could be associated with deployment activities (vehicles and other motorized construction equipment) and would have no long-term or permanent impact on GHG emissions or climate change. Long-term (both temporary and permanent) emission increases could result from operations, including the use of grid-provided electricity by FirstNet equipment such as transmitters and optical fiber, and from the temporary use of portable or on-site electric generators (a less efficient, more carbon-intensive source of electricity), during emergency situations when the electric grid was down, for example after a hurricane.

A single large cell tower would typically require 20-60kW of power to operate (Balshe, 2011). The CO_2 emissions associated with the operation of the tower would depend on whether it was supplied by a stand-alone power source, such as a generator, or from the grid, and whether it was operating at full power on a continuous basis. A standard 60kW 3-phase diesel generator consumes approximately 5.0 gallons of diesel per hour (Diesel Service & Supply, 2016). Diesel fuel combustion emits 22.38 lbs of CO_2 per gallon (EIA, 2015c). A 60kW transmitter running on a generator would therefore be responsible for 1,221 kg of CO_2/day. Running continuously, the tower would cause the emission of 446 MT of CO2 per year.

However, grid-provided electricity would result in less CO_2 emissions than on-site provided energy. Using the average carbon intensity of grid-provided electricity of 1,136.53 lbs/MWh (USEPA, 2015n), 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. Actual emissions would depend on the fuel mix and efficiency of the systems from which electricity was generated. Some may even run on low/no-emissions renewable energy. Therefore, this scenario is a "worst-case" for GHG emissions. If the system deployment resulted in the operation of more than 50 60 kW towers operating at maximum power in remote locations on diesel generators on a continuous basis, the 25,000 MT/year threshold may be exceeded and a quantitative analysis required. By comparison optical fiber is considerably more energy efficient and consumes considerably less power than transmitters (Vereecken et al., 2011), and would not impact GHG emissions in such a way as to require a quantitative analysis.

Impact of Climate Change on Project-Related Resource Effects

Climate change may impact project-related effects by magnifying or otherwise altering impacts in other resources areas. For example, climate change may impact air quality, water resource availability, and recreation. These effects would vary from state to state depending on the resources in question and their relationship to climate change. The severity and length of droughts is expected to increase in Colorado as snow pack is reduced and temperatures rise, adding to existing stress to natural and agricultural ecosystems (State of Colorado, 2015b). This in turn may contribute to more frequent and larger wildland fires (USGCRP, 2014d) as well as increased fuel load in the form of dead trees caused by invasive bark beetles (USFS, 2015f). These fires may negatively impact or transform ecosystems as well as threatening lives and property (State of Colorado, 2015b).

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. Areas of Colorado at risk of flooding are expected to experience increased risk under warming scenarios: climate change is projected to increase the frequency and severity of torrential downpours, which in turn may increase the potential for flash floods (USGCRP, 2014e). Climate change may expose areas of Colorado to more intense and longer heat waves (USGCRP, 2014e) although Colorado does not have large population centers with the significant urban heat islands of other states (with the possible exception of Denver) that would greatly magnify these effects. This could increase the demand for electricity for HVAC in the Southwest and thereby increase stress on the electric grid (DOE, 2015).

3.2.14.5. Potential Impacts of the Preferred Alternative

Greenhouse Gas Emissions

The following section assesses potential GHG emission impacts associated with implementation of the Preferred Alternative in Colorado, 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, the following are likely to have no impacts to climate change under the conditions described below:

- Wired Projects
  - Use of Existing Conduit – New Buried Fiber Optic Plant: There would be no short-term emissions associated with construction, as construction would not take place. The equipment required to blow or pull fiber through existing conduit would be used temporarily and infrequently, resulting in no perceptible generation of GHG emissions.
  - Use of Existing Buried or Aerial Fiber Optic Plant or Existing Submarine Cable: Lighting up dark fiber would require no construction and have no short- or long-term emissions. This would create no perceptible change in GHG emissions.
- Satellites and Other Technologies
  - Satellite Enabled Devices and Equipment: The installation of satellite-enabled equipment on existing structures, or the use of portable satellite-enabled devices would not create any perceptible changes in GHG emissions because they would not create any new emissions sources.
  - Deployment of Satellites: FirstNet does not anticipate launching satellites as part of the NPSBN; however, it could include equipment on satellites that are already being launched for other purposes. Therefore it is anticipated that there would be no GHG emissions or any climate change effects on the project because of these activities.

Activities with the Potential to Have Impacts

The deployment and use of energy-consuming equipment as a result of the implementation of the Preferred Alternative would result in GHG emissions whose significance would vary depending on their power requirements, duration and intensity of use, and number. The types of infrastructure deployment scenarios that could be part of the Preferred Alternative and result in potential impacts to GHG emissions and climate change include the following:

- Wireless 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 installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
- Installation of Optical Transmission or Centralized Transmission Equipment: The construction of small boxes or huts or other structures would require construction equipment, which could generate GHG emissions.

- Wireless Projects
  - New Wireless Tower Construction: Installation of new wireless towers and associated structures (generators, equipment sheds, fencing, security and aviation lighting, electrical feeds, and concrete foundations and pads) or access roads could result in short-term, temporary GHG emissions from vehicles and construction equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
  - Collocation on Existing Wireless Tower, Structure, or Building: Collocation would involve mounting or installing equipment (such as antennas or microwave dishes) on existing towers. There would be no short-term GHG emissions associated with construction as construction would not take place. Minor, short-term, temporary GHG emissions may result from any associated equipment used for installation, such as cranes or other equipment. Long-term, permanent or temporary increases in GHG emissions would result from the electricity requirements of the towers (both grid-provided and back-up), and would depend on their size, number, and the frequency and duration of their use.
- Deployable Technologies
  - COWs, COLTs, 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Climate Change Impacts on FirstNet Infrastructure or Operations

Climate change effects on the Preferred Alternative could be potentially significant to less than significant with BMPs and mitigation measures incorporated because climate change may potentially impact FirstNet installations or infrastructure during periods of extreme heat, severe storms, and other weather events. FirstNet installations should be evaluated in the design and planning phase through tiering to this analysis, in the context of their local geography and anticipated climate hazards to ensure they are properly hardened or there is sufficient redundancy to continue operations in a climate-affected environment. Mitigation measures could minimize or reduce the severity or magnitude of a potential impact to the project, including adaptation, which refers to anticipating adverse effects of climate change and taking appropriate action to prevent and minimize the damage climate change effects could cause.

Climate change's anticipated impact on extreme weather events such as hurricanes or heat waves may increase the severity of the emergencies to which first responders are responding in vulnerable areas, and thus the extent and duration of their dependence on FirstNet resources. FirstNet would likely prepare to sustain these operations in areas experiencing climate and weather extremes through the design and planning process for individual locations and operations.

3.2.14.6. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration.

Potential Deployment Impacts

As explained above, implementation of deployable technologies could involve use of fossil-fuel-powered vehicles, powered generators, and/or aerial platforms. There could be some emissions and soil and vegetation loss as a result of excavation and grading for staging and/or landing areas depending on the type of technology. GHG emissions are expected to be less than significant based on the defined significance criteria, since activities would be temporary and short-term.

Potential Operations Impacts

Implementing land-based deployable technologies (COW, COLT, SOW) could result in emissions from mobile equipment on heavy trucks using internal combustion engines associated with the vehicles and onboard generators. While a single deployable vehicle may have an insignificant impact, multiple vehicles operating for longer periods, in close proximity, may have a cumulative impact, although this impact is expected to be less than significant. Some staging or landing areas (depending on the type of technology) may require excavation, site preparation, and paving. Heavy equipment used for these activities could produce emissions as a result of burning fossil fuels in internal combustion engines. The deployment and operation of aerial technology is anticipated to generate pollutants during all phases of flight, except for balloons. These activities are expected to be less than significant due to the limited duration of deployment activities.

Additionally, routine maintenance and inspections of the deployable technologies are anticipated to be less than significant, given that these activities are of low-intensity and short duration.

Climate Change Impacts on FirstNet Deployable Infrastructure or Operations

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. These projects may also consist of deploying aerial vehicles including, but not limited to, drones, balloons, blimps, and piloted aircraft, which could involve fossil fuel combustion. Climate change effects have the most noticeable impacts over a long period of time. Climate change effects such as temperature, precipitation changes, and extreme weather during operations would be expected but could have little to no impact on the deployed technology 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.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure, or satellites and other technologies. As a result, there would be no impacts to GHG emissions or climate as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.14, Climate Change.

3.2.15. Human Health and Safety

3.2.15.1. Introduction

This section describes potential impacts to human health and safety in Colorado associated with deployment of the Proposed Action and Alternatives. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.15.2. Impact Assessment Methodology and Significance Criteria

The impacts of the Proposed Action on human health and safety were evaluated using the significance criteria presented in Table 3.2.15-1. The categories of impacts are defined as potentially significant, less than significant with mitigation incorporated, less than significant, or no impact. Characteristics of each impact type, including magnitude or intensity, geographic extent, and duration or frequency, were used to determine the impact significance rating associated with each potential impact.

Given the nature of this programmatic evaluation, and because the Proposed Action could potentially cover a wide variety of actions that would take place in various landscapes, the potential impacts to human health and safety addressed in this section are presented as a range of possible impacts.

Table 3.2.15-1: Impact Significance Rating Criteria for Human Health and Safety

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Worksite Occupational Hazards as a Result of Activities at Existing or New FirstNet Sites	Magnitude or Intensity	Exposure to concentrations of chemicals above occupational regulatory limits and time weighted averages (TWAs). A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Exposure to recognized workplace safety hazards (physical and chemical). Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unsafe working conditions or other workplace safety hazards.	No exposure to chemicals, unsafe working conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
Exposure to Hazardous Materials, Hazardous Waste, and Mine Lands as a Result of FirstNet Site Selection and Site-Specific Land Disturbance Activities	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. A net increase in the amount of hazardous or toxic materials or wastes generated, handled, stored, used, or disposed of, resulting in unacceptable risk, exceedance of available waste disposal capacity and probable regulatory violations. Site contamination conditions could preclude development of sites for the proposed use. Violations of various regulations including: OSHA, RCRA, CERCLA, TSCA, EPCRA. Unstable ground and seismic shifting.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No exposure to unstable ground conditions or other workplace safety hazards.	No exposure to chemicals, unstable ground conditions, or other workplace safety hazards.
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA
Exposure to Hazardous Materials, Hazardous Waste, and Occupational Hazards as a Result of Natural And Man-Made Disasters	Magnitude or Intensity	Exposure to concentrations of chemicals above regulatory limits, or USEPA chemical screening levels protective of the general public. Site contamination conditions could preclude development of sites for the proposed use. Physical and biologic hazards. Loss of medical, travel, and utility infrastructure.	Effect is potentially significant, but with mitigation is less than significant.	No exposure to chemicals above health-protective screening levels. Hazardous or toxic materials or wastes could be safely and adequately managed in accordance with all applicable regulations and policies, with limited exposures or risks. No	No exposure to chemicals, unsafe conditions, or other safety and exposure hazards.

Type of Effect	Effect Characteristics	Impact Level			
		Potentially Significant	Less than Significant with BMPs and Mitigation Measures Incorporated	Less than Significant	No Impact
				exposure to unsafe conditions. No loss of medical, travel, or utility infrastructure.	
	Geographic Extent	Regional impacts observed ("regional" assumed to be at least a county or county-equivalent geographical extent, could extend to state/territory).		Impacts only at a local/neighborhood level.	NA
	Duration or Frequency	Occasional frequency during the life of the project.		Rare event.	NA

NA = Not Applicable

3.2.15.3. Description of Environmental Concerns

Worksite Physical Hazards, Hazardous Materials, and Hazardous Waste

The human health and safety concern having the greatest likelihood to occur during FirstNet deployment activities is occupational injury to telecommunication workers. The nature of telecommunication work requires workers to execute job responsibilities that are inherently dangerous. Telecommunication work activities present physical and chemical hazards to workers. The physical hazards have the potential to cause acute injury, long-term disabilities, or in the most extreme incidents, death. Other occupational activities such as handling hazardous materials and hazardous waste often do not result in acute injuries, but may compound over multiple exposures, resulting in increased morbidity. Based on the impact significance criteria presented in Table 3.2.15-1, occupational injury impacts could be potentially significant if the FirstNet deployment locations require performing occupational activities that have the highest relative potential for physical injury and/or chemical exposure. Examples of activities that may present increased risk and higher potential for injury include working from heights (i.e., from towers and roof tops), ground-disturbing activities like trenching and excavating, confined space entry, operating heavy equipment, and the direct handling of hazardous materials and hazardous waste. Predominately, these hazards are limited to occupational workers, but may impact the general public if there are trespassers or if any physical of chemical hazard extends beyond the restricted access of proposed FirstNet work sites.

To protect occupational workers, OSHA mandates that employers be required to protect their employees from occupational hazards that could result in injury. Depending on the source of the hazard and the site-specific work conditions, OSHA generally recommends the following hierarchy for protecting onsite workers (OSHA, 2015b).

1.) Engineering controls,
2.) Work practice controls,
3.) Administrative controls, and then
4.) Personal protective equipment (PPE).

Engineering controls are often physical barriers that prevent access to a worksite, areas of a worksite, or from idle and operating equipment. Physical barriers take many forms like perimeter fences, trench boxes,[163] 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.

[163] Trench boxes are framed metal structures inserted into open trenches to support trench faces, to protect workers from cave-ins and similar incidents. (OSHA, 2016c)

Work practice controls could be implemented as abiding by specific OSHA industry standards, such as the Confined Space Entry standard (29 CFR 1910.146) or thru the development of employer specific workplace rules and operational practices (OSHA, 2015b). To the extent practicable, FirstNet partner(s) would likely implement and abide by work practice controls through employee safety training and by developing site-specific health and safety plans (HASP). The HASPs would identify all potential hazardous materials and hazardous wastes, potential physical hazards, and applicable mitigation steps. Other components of a HASP identifying appropriate PPE for each task and the location of nearby medical facilities. Safety Data Sheets (SDS) describing the physical and chemical properties of hazardous materials used during FirstNet deployment and maintenance activities, as well as the physical and health hazards, routes of exposure, and precautions for safe handling and use would be kept and maintained at all FirstNet project sites. In addition to HASPs and SDSs, standard operating procedures (SOP) would be developed and implemented by FirstNet partner(s) for critical and/or repetitive tasks that require attention to detail, specialized knowledge, or clear step-wise directions to prevent worker injury and to ensure proper execution.

Administrative controls are employer-initiated methods to reduce the potential for injury and physical fatigue (OSHA, 2015b). Administrative controls may take the form of limiting the number of hours an employee is allowed to work per day, requiring daily safety meetings before starting work, utilizing the buddy system for dangerous tasks and any other similar activity or process that is designed to identify and mitigate unnecessary exposure to hazards. When engineering controls, work practice controls, and administrative controls are not feasible or do not provide sufficient protection, employers must also provide appropriate PPE to their employees and ensure its proper use. PPE is the common term used to refer to the equipment worn by employees to minimize exposure to chemical and physical hazards. Examples of PPE include gloves, protective footwear, eye protection, protective hearing devices (earplugs, muffs), hard hats, fall protection, respirators, and full body suits. PPE is the last line of defense to prevent occupational injuries and exposure. (OSHA, 2015b)

The Colorado Department of Labor and Employment (CODOLE) is not authorized by OSHA to administer a state program to oversee employee safety in public sector or private sector workplaces. Therefore, CODOLE defers all regulatory authority and enforcement for occupational safety relating to FirstNet site work to the leadership and interpretation of OSHA.

Hazardous Materials, Hazardous Waste, and Mine Lands

The presence of environmental contamination at FirstNet deployment sites has the potential to negatively impact health and safety of workers and the general public. Past or present contaminated media, such as soil and groundwater, may be present and become disturbed as a result of site activities. Mines may cause unstable surface and subsurface conditions as a result of underground shaft collapses or seismic shifting. Based on the impact significance criteria presented in Table 3.2.15-1, human health impacts could be significant if FirstNet deployment sites are near contaminated properties. Prior to the start of any FirstNet deployment project, potential site locations should be screened for known environmental contamination and/or mining activities using federal resources such as the USEPA Cleanups in My Community database and U.S. Department of Interior's Abandoned Mine Lands inventory, through the CODHE, or through an equivalent commercial resource.

By screening sites for environmental contamination or 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, the more favorable the site will be for FirstNet deployment projects. If sites containing known environmental contamination are selected for proposed FirstNet deployment activities it may be necessary to implement additional controls (e.g., engineering, work practice, administrative, and/or PPE) to ensure workers, and the general public, are not unnecessarily exposed to the associated hazards. Additionally, for any proposed FirstNet deployment site, it is possible undocumented environmental contamination is present.

During FirstNet deployment activities, if any soil or groundwater is 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 likely 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 Colorado state laws in order to protect workers and the general public from direct exposure or fugitive contamination.

Exposure assessments identify relevant site characteristics, temporal exposure parameters, and toxicity data to determine the likelihood of adverse health effects. More formally known as a human health risk assessment (HHRA), these studies provide mathematical justification for implementing controls at the site to protect human health. If the HHRA determines the potential for adverse health effects is too great DNREC may require FirstNet to perform environmental clean-up actions at the site to lower the existing levels of contamination. HHRAs help determine which level of PPE (i.e., Level D, Level C, Level B, or Level A) is necessary for a work activity. HHRAs take into account all exposure pathways: absorption, ingestion, inhalation, and injection. Therefore, specific protective measures (e.g., controls and PPE) that disrupt the exposure pathways could be identified, prioritized, and implemented.

Natural and Manmade Disasters

The impacts of natural and manmade disasters are likely to present unique health and safety hazards, as well as exacerbate pre-existing hazards, such as degrading occupational work conditions and disturbing existing environmental contamination. The unique hazards presented by natural and manmade disasters may include, fire, weather incidents (e.g., floods, tornadoes, hurricanes, etc.), earthquakes, vandalism, large- or small-scale chemical releases, utility disruption, community evacuations, or any other event that abruptly and drastically denudes the availability or quality of transportation infrastructure, utility infrastructure, medical infrastructure, and sanitation infrastructure. Additionally, such natural and manmade disasters could directly impact public safety communication infrastructure assets through damage or destruction.

Based on the impact significance criteria presented in Table 3.2.15-1, human health impacts could be significant if FirstNet deployment sites are located in areas that are directly impacted by natural and manmade disasters that could lead to exposure to hazardous wastes, hazardous materials, and occupational hazards. FirstNet's emphasis on public safety-grade communications infrastructure may result in a less than significant beneficial impact, as new infrastructure could be deployed with additional structural hardening, and existing infrastructure may also be hardened as appropriate and feasible, in an effort to reduce the possibility of infrastructure damage or destruction to some degree.

Potential mitigation measures for natural disasters is to be aware of current weather forecasts, forest fire activities, seismic activities, and other news worthy events that may indicate upcoming disaster conditions. Awareness provides time and opportunity to plan evacuation routes, to relocate critical equipment and parts, and to schedule appropriate work activities preceding and after the natural disaster. These mitigation steps reduce the presence of workers and dangerous work activities to reduce the potential for injury or death. Manmade disasters could be more difficult to anticipate due to the unexpected or accidental nature of the disaster. Though some manmade disasters are due to malicious intentions, many manmade disasters result from human error or equipment failure. The incidence of manmade disasters affecting FirstNet deployment sites would be difficult to predict and diminish because the source of such disasters is most likely to originate from sources independent of FirstNet activities. Therefore, FirstNet partner(s) would develop disaster response plans that outline specific steps employees should take in the event of a natural or manmade disaster.

3.2.15.4. Potential Impacts of the Preferred Alternative

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

Deployment Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, implementation of the Preferred Alternative could result in the deployment of various types of facilities or infrastructure. Depending on the physical nature and location of the facility/infrastructure and the specific deployment requirements, some activities would result in potential impacts to human health and safety and others would not. In addition, and as explained in this section, the same type of Proposed Action Infrastructure could result in a range of no impacts to less than significant with mitigation, depending on the deployment scenario or site-specific activities.

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 to 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 would require the use of heavy equipment and hazardous materials. The additional noise and activity at the site would require workers to demonstrate a high level of situational awareness. Failure to follow OSHA and industry controls could result in injuries. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. Additionally, some of this work would likely be performed along road ROWs, increasing the potential for vehicle traffic to collide with site workers or equipment. If a proposed deployment activity involves the operation of heavy equipment, managing hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
  - New Build – Aerial Fiber Optic Plant: Installation of new poles and fiber optic lines could require excavation activities, working from heights, use of hazardous materials, and site locations in ROWs. Hazards associated with the site work include injury from heavy

equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.

- Collocation on Existing Aerial Fiber Optic Plant: Installation of overhead fiber optic lines would require work from height. In some instances, new poles would be installed requiring excavation activities with heavy equipment. Hazards associated with the site work include injury from heavy equipment, fall hazards, chemical hazards, and the potential for vehicle traffic to collide with site workers or equipment. Excavation of soil at proposed sites known to contain environmental contamination has the potential to expose workers to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider.
- New Build – Submarine Fiber Optic Plant: The installation of cables in or near bodies of water would not impact infrastructure resources because there would be no local infrastructure to impact. However, impacts to infrastructure resources could potentially occur as result of the construction of landings and/or facilities on shores or the banks of water bodies that accept the submarine cable, depending on the exact site location and proximity to existing infrastructure.
- Installation of Optical Transmission or Centralized Transmission Equipment: Installation of transmission equipment 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 radio frequency emissions, refer to Section 2.4, 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. This would require workers to perform their duties from heights sufficient to result in serious injury or death in the event of falling not result in impacts to soils. Working from heights may also result in additional overhead hazards and falling objects. Excavation of soils at proposed sites known to contain environmental contamination may result in workers being exposed to harmful chemicals or releases that could impact the general public in the immediate vicinity. If a proposed deployment activity involves the operation of heavy equipment, hazardous materials and hazardous waste management, or other site location challenges, there could be potential human health and safety impacts to consider. For a discussion of radio frequency emissions, refer to Section 2.4, RF Emissions.

- Deployable Technologies
  - The use of deployable technologies could result in soil disturbance if land-based deployables are deployed on unpaved areas or if the implementation results in paving of previously unpaved surfaces. The use of heavy machinery presents the possibility for spills and soil and water contamination, and noise emissions could potentially impact human health; and vehicles and heavy equipment present the risk of workplace and road traffic accidents that could result in injury. Set-up of a cellular base station contained in a trailer with a large expandable antenna mast is not expected to result in impacts to human health and safety. However, due to the larger size of the deployable technology, site preparation or trailer stabilization may be required to ensure the self-contained unit is situated safely at the site. Additionally, the presence of a dedicated electrical generator would produce fumes and noise. The possibility of site work and the operation of a dedicated electrical generator have the potential for impacts to human health and safety. For a discussion of radio frequency emissions, refer to Section 2.4, Radio Frequency Emissions. Use of aerial vehicles would not involve telecommunication site work. Prior to deployment and when not in use, the aerial vehicles would likely require preventive maintenance. Workers responsible for these activities may handle hazardous materials, not limited to fuel, solvents, and adhesives.
- Satellites and Other Technologies
  - Satellite-Enabled Devices and Equipment: The use of portable devices that utilize satellite technology would not impact human health and safety because there is no construction activities or use of hazardous materials. The installation of permanent equipment on existing structures may require workers to operate from heights or in sensitive environments. As a result, the potential for falling, overhead hazards, and falling objects is greater and there is a potential to impact human health and safety.

In general, the abovementioned FirstNet activities could potentially involve site preparation work, construction activities, work in potentially harmful environments (road ROWs, work over water, and environmental contamination), management of hazardous materials and hazardous waste, and weather exposure. Potential impacts to human health and safety associated with deployment of the Proposed Project could include injury from site preparation and operating heavy equipment, construction activities, falling/overhead hazards/falling objects, exposure, and release of hazardous chemicals and hazardous waste, and release of historic contamination to the surrounding environment. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise 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 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As described in Section 2.1.2, Proposed Action Infrastructure, operation activities associated with the Preferred Alternative would consist of routine maintenance and inspection of the facilities. Any major infrastructure replacement as part of ongoing system maintenance would result in impacts similar to the abovementioned construction impacts. It is anticipated that there would be less than significant impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures could be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents, and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

3.2.15.5. Alternatives Impact Assessment

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

Deployable Technologies Alternative

Under the Deployable Technologies Alternative option, a nationwide fleet of mobile communications systems would provide temporary coverage in areas not covered by the existing, usable land-based infrastructure. There would be no collocation of equipment and minimal new construction associated with wired or wireless projects discussed above under the Preferred Alternative. Some limited construction could be associated with implementation such as land clearing or paving for parking or staging areas. The specific infrastructure associated with the Deployable Technologies Alternative would be the same as the deployable technologies implemented as part of the Preferred Alternative but would likely be implemented in greater numbers, over a larger geographic extent, and used with greater frequency and duration. Therefore, potential impacts to human health and safety as a result of implementation of this alternative could be as described below.

Deployment Impacts

As explained above, implementation of deployable technologies could result in less than significant impacts to human health and safety. The largest of the land-based deployable technologies may require site preparation work or stabilization work to ensure the self-contained trailers are stable. Heavy equipment may be necessary to complete the site preparation work. However, in general, the deployable technologies are small mobile units that could be transported as needed. While in operation, the units are parked and operate off electrical generators or existing electrical power sources. Connecting deployable technology to a power supply may present increased electrocution risk during the process of connecting power. If the power source is an electrical generator, then there would also likely be a need to manage hazardous materials (fuel) onsite. These activities could result in less than significant impacts to human health and safety. It is anticipated that potential health impacts associated with human exposure to environmental hazardous materials in air, water, or soil, the risk of road traffic, workplace accidents and injuries, noise exposure, and risk of infectious disease transmission would be less than significant due to the small scale of likely FirstNet activities that would be temporary and of short duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

Operation Impacts

As explained above, operation activities would consist of implementation/running of the deployable technology and routine maintenance and inspections. As with the Preferred Alternative, it is anticipated that there would be no impacts to human health and safety associated with routine inspections of the Preferred Alternative, assuming that the inspections do not require climbing towers or confined space entry. In those instances, PPE or other mitigation measures may be necessary to adequately protect workers. If usage of heavy equipment is part of routine maintenance, the potential for impacts to human health and safety would also increase. These impacts would be less than significant because of the small scale of likely FirstNet activities; activities associated would routine maintenance, inspection, and deployment of deployable technologies would be temporary and often of limited duration. Chapter 19, BMPs and Mitigation Measures, provides a listing of BMPs and mitigation measures that FirstNet and/or its partners would require, as practicable or feasible, to avoid or minimize potential impacts.

No Action Alternative

Under the No Action Alternative, the NPSBN would not be deployed; therefore, there would be no associated construction or installation of wired, wireless, deployable infrastructure or satellites and other technologies. As a result, there would be no impacts to human health and safety as a result of deployment and operation of the Proposed Action. Environmental conditions would therefore be the same as those described in Section 3.1.15, Human Health and Safety.

CO APPENDIX A – WATER RESOURCES

Table A-1: Characteristics of Colorado's Watersheds, as Defined by Colorado CWCB

Watershed/Size Land Area within CO (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
Arkansas River (28,268)	Arkansas River John Martin Reservoir	• Existing water rights, including Arkansas River Compact requirements, means there is little water availability for new users. • Demand for water will continue to grow in the headwaters region. • Adequate drinking water and water quality are concerns in the lower basin.
Colorado River (9,830)	Colorado River Granby Reservoir Dillon Reservoir	• Population growth combined with a lack of water storage and supply in the headwaters areas is a major challenge. • Economic drivers include recreation and the environment, while agriculture is also important in the lower basin. • The Upper Colorado Recovery Implementation Program for Colorado River Endangered Fish is vital to address recovery of the Colorado River endangered fish while still allowing for existing and future water uses of Colorado River water in accordance with Interstate Compacts, Treaties, and applicable federal and state law "the Law of the Colorado River." • Potential water shortages during severe and prolonged drought could result in compact shortage. • Water rights associated with transbasin projects and their impact on in-basin supplies is a growing concern.
Gunnison Basin (8,000)	Gunnison River Blue Mesa Reservoir	• Population growth in the headwaters area. • Agricultural water shortages and lack of financial resources in the upper portion of the basin. • Future transbasin diversions could affect the basin's supply. • Federal issues including National Park Service claims for flows in the Black Canyon, Environmental Impact Statement for completion of the Blue Mesa/Aspinall reoperations, and Endangered Species concerns in the Gunnison River near the Colorado River main stem confluence. • Rapid growth in areas between Ouray and Montrose, with tourism and agriculture as competing uses in the Uncompahgre Valley.
North Platte Basin (2,050)	North Platte River Lake John	• This is the only basin in Colorado that has concerns over the lack of economic development and growth. • Protection of existing water supplies. • Concern over lack of forest management.

Watershed/Size Land Area within CO (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
		• Endangered Species concerns on the Platte River in Central Nebraska need to be resolved without pressuring existing water use. • Available water and land that can be irrigated, due to equitable apportionment decrees on the Laramie and North Platte Rivers.
Rio Grande (7,543)	Rio Grande River Sanchez Reservoir	• New water development is difficult due to prolonged drought at the requirements of the Rio Grande Compact. • Agricultural water use is not sustainable in the Rio Grande Valley. • Groundwater use is important.
South Platte Basin (27,660)	South Platte River Horsetooth Reservoir	• Fierce competition for water supplies. • This is the most industrialized and diverse basin; although agriculture is still the dominant water user, rapid population growth is a key concern. • The Upper Colorado Recovery Implementation Program for Colorado River Endangered Fish is vital to address recovery of the Colorado River endangered fish while still allowing for existing and future water uses of Colorado River water in accordance with Interstate Compacts, Treaties, and applicable federal and state law “the Law of the Colorado River.” • Lack of new major water storage projects in the last 20 years, combined with explosive population growth and lack of surface water supply, has increased reliance on groundwater supplies in Arapahoe, Douglas, and northern El Paso counties.
Southwest Basin (10,169)	Dolores River San Juan River San Miguel River	• Localized water shortages are occurring in the Pagosa Springs/Bayfield/Durango corridor due to population growth and a shift from agriculture and mining to tourism, recreation, and retirement/second home use. • The Upper Colorado Recovery Implementation Program for Colorado River Endangered Fish is vital to address recovery of the Colorado River endangered fish while still allowing for existing and future water uses of Colorado River water in accordance with Interstate Compacts, Treaties, and applicable federal and state law “the Law of the Colorado River.” • Adequate infrastructure and water distribution is a challenge • The San Juan River is the primary source of supply for New Mexico's Colorado River Basin Compact appointment, placing pressure on users of the river.
Yampa/White/ Basin (10,500)	Yampa River White River Green River	• Some areas of the basin are growing rapidly (Yampa/Steamboat Springs area) but others are not, raising concerns that the basin is not receiving a “fair share” of water use as afforded under the Colorado River Compact.

Watershed/Size Land Area within CO (square miles)	Major Surface Waterbodies	Major Water Quality Concerns
	Stagecoach Reservoir	• The Upper Colorado Recovery Implementation Program for Colorado River Endangered Fish is vital to address recovery of the Colorado River endangered fish while still allowing for existing and future water uses of Colorado River water in accordance with Interstate Compacts, Treaties, and applicable federal and state law "the Law of the Colorado River."

Sources: (CWCB, 2006a); (CWCB, 2006b); (CWCB, 2006c); (CWCB, 2006d); (CWCB, 2006e); (CWCB, 2006f); (CWCB, 2006g); (CWCB, 2006h)

CO APPENDIX B – COMMUNITIES OF CONCERN

Table B-1: CNHP S1 Ranked Natural Plant Communities of Colorado

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
Woodlands				
Boxelder/ River Birch	*Acer negundo/ Betula occidentalis* Woodland	Colorado Plateau	A riparian[164] woodland community that grows in narrow, sandstone box canyons of western Colorado. Composition includes: boxelder *(Acer negundo)* is the dominant overstory, riverbirch *(Betula occidentalis)* is the dominant shrub layer species with some narrowleaf *willow (Salix exigua)*, stretchberry *(Forestiera pubescens)*, and western white clematis *(Clematis ligusticifolia)* also present. The herbaceous layer is sparse (Sarr 1997).	This community has been found in western Colorado.
Douglas Fir/Creeping Oregon-grape	*Pseudotsuga menziesii/ Mahonia repens* Forest	Southern Rockies	A forest community that occurs in lower mountain and upper canyon slopes of nutrient-poor sites. Found in the southern and central Rocky Mountains and on the Colorado Plateau at elevations of 5,700 to 9,600 feet (1,737 to 2,926 m). Douglas fir *(Pseudotsuga menziesii)* represents the majority of the closed canopy with some ponderosa pine *(Pinus ponderosa)*, lodgepole pine *(Pinus contorta)*, limber pine *(Pinus flexilis)*, southwestern white pine *(Pinus strobiformis)*, quaking aspen *(Populus tremuloides)*, or Rocky Mountain juniper *(Juniperus scopulorum)*. The understory is sparse, with total herbaceous cover being ≤10% or a combination of shrub and herbaceous cover being ≤30%. Creeping barberry *(Mahonia repens)* is the dominant shrub/herbaceous cover (Coles & Schulz 2008a).	This community has been found in southern Colorado.
Engelmann Spruce/White Marsh Marigold	*Picea engelmannii - (Abies lasiocarpa)/ Caltha leptosepala* Forest	Southern Rockies	Forest community that occurs along streambanks and terraces east of the Continental Divide at elevations of 8,200 to 9,500 feet. Engelmann spruce *(Picea engelmannii)* dominates overstory with some lodgepole pine, whitebark pine *(Pinus albicaulis)*, and stunted subalpine fir *(Abies lasiocarpa)*. The shrub layer	This community has been found in north central Colorado.

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

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			contains little diversity and includes dwarf bilberry *(Vaccinium caesptosum)* and grouse whortleberry *(Vaccinium scoparium)*. The herbaceous layer contains much diversity including white marsh marigold *(Caltha leptosepala)* and American globeflower *(Trollis laxus)* being dominant (Engelking 2004).	
Foothills Ponderosa Pine Savannas	*Pinus ponderosa Schizachyrium scoparium* Woodland	Southwestern Tablelands	A dry woodland found on south- and west-facing slopes of waterways, hills, mesa tops, upper canyon slopes, and rocky breaks. Found in the Great Plains at elevations of 5,840 to 7,970 feet. Ponderosa pine dominates the overstory with some Rocky Mountain juniper scattered throughout. Rocky mountain juniper, three-leaf sumac *(Rhus trilobata)*, and snowberry *(Symphoricarpos spp.)* comprise the shrub layer. Little bluestem is the dominant graminoids (Drake et al. 2010).	This community has been found in eastern Colorado.
Lower Montane Forests	*Corylus cornuta* Shrubland [Provisional]	Southern Rockies, Southwestern Tablelands	A shrubland community dominated by beaked hazelnut (*Corylus cornuta*). Beaked hazelnut can be found in north-central Colorado and is a dominant shrub and/or tree stratum species. Beaked hazelnut typically grows in moist to dry areas along roadways, fencerows, pastures, thickets, forest edges, and in open woodlands and forests. It typically grows from 300 to 2,000 ft (100 to 500 m) in elevation (Fryer 2007).	This community has been found in the central region of Colorado.
	Pseudotsuga menziesii/ Acer glabrum Forest	Arizona/New Mexico Plateau, Colorado Plateaus, Southern Rockies	A montane forest community that occurs in cool, moist locations on northern and eastern steep, mid to lower slopes and raving and stream bottoms. Found in the central and northern Rocky Mountains at elevations of 4,800 to 8,700 feet (1,463 to 2,651 m). Douglas fir dominates the overstory and Rocky Mountain maple *(Acer glabrum)* dominates or codominates the understory tall shrub layer. A short shrub layer is also present and is dominated by mallow ninebark *(Physocarpus malvaceus)*. The herbaceous layer usually has low cover and is comprised of a variety of species (Schulz et al. 2007).	This community has been found on the western slope in the far west, central, and southwestern regions of Colorado.
Mixed Montane Forests	*Abies concolor/*	Unknown	A montane forest community that occurs in colluvial slopes and sand ramps on gentle to steep northwest-facing slopes in	The distribution of this

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Festuca arizonica Woodland		the mountains of Arizona, New Mexico, Colorado, and Wyoming at elevations of 8,645 to 9,678 feet. Open to moderate dense tree canopy is dominated by Douglas fir and white fir *(Abies concolor).* Snowberry, fringed sage *(Artemisia frigida),* and trumpet gooseberry *(Ribes leptanthum)* dominate the sparse shrub layer. The herbaceous layer is graminoid-dominated, but has fair diversity in forbs. Dominant species include Arizona *fescue (Festuca arizonica)* and muttongrass *(Poa fendleriana)* (Sabo & Russo 2010).	community is unknown.
	Picea pungens/ Linnaea borealis Forest	Unknown	A forest community found within the Rocky Mountain Dry-mesic and Mesic Montane Mixed Conifer Forest and Woodland system. This system is composed of mixed-conifer forests at elevations of 4,000 to 10,800 ft (1,200 to 3,300 m). Associations within this system vary in structure and composition with varying temperature, moisture, and successional stage (CNHP 2005a). Blue spruce (*Picea pungens*) and twinflower (*Linnaea borealis*) are dominant species.	The distribution of this community is unknown.
Montane Riparian Forests	*Populus tremuloides/ Corylus cornuta* Forest	Southern Rockies	An upland forest community often found on more northerly aspects on gently sloping topography in the northwestern Great Plains and Rocky Mountains. The moderately closed canopy is dominated by quaking aspen *(Populus tremuloides)* and paper birch *(Betula papyifera)* may codominate. The shrub layer is obvious and is dominated by beaked hazelnut *(Corylus cornuta).* The herbaceous layer is also obvious, with few graminoids. Species present include wild sarsaparilla *(Aralia nudicaulis),* cream pea *(Lathyrus nissolia),* Canada mayflower *(Maianthemum canadense),* fragrant bedstraw *(Galium aparine),* starry false lily of the valley *(Maianthemum stellatum),* violet *(Viola spp.),* and Maryland sanicle *(Sanicula marilandica)* (Drake 1995a).	This community has been found near the transition area of the High Plains to the Southern Rockies ecoregions in Colorado.
Narrowleaf Cottonwood/ Common Chokecherry	*Populus angustifolia/ Prunus virginiana* Woodland	Southern Rockies	A riparian woodland community in foothill areas that occurs in narrow to moderately broad stream valleys and in narrow canyons on elevated sloping stream banks at elevations of 5,240 to	The community has been found in the central and north-central parts of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			8,200 feet. A moderately dense overstory is dominated by narrowleaf cottonwood *(Populus angustifolia)* or lanceleaf cottonwood *(Populus x acuminate)*. The shrub layer is also moderately dense and is dominated primarily by chokecherry *(Prunus virginiana)*. Introduced perennial grasses frequently dominate the moderate to dense herbaceous cover and includes Kentucky bluegrass *(Poa pratensis)*, redtop *(Agrostis gingantea)*, smooth brome *(Bromus inermis)*, among many other species (Jones et al. 2009).	
No common name	*Juniperus monosperma/ Quercus x pauciloba* Woodland	Southwestern Tablelands	A woodland community typically found on gentle to moderate slopes at elevations 6,840 to 7,000 feet on basalt-derived substrates. The tree canopy is typically comprised of open coverage from oneseed juniper *(Juniperus monosperma)* and some pinyon pine *(Pinus edulis)* on occasion. The shrub layer is primarily composed of wavy leaf oak *(Quercus x pauciloba)*. Herbaceous vegetation cover is low and is dominated by graminoids such as blue grama *(Bouteloua gracilis)*, side oats grama *(Bouteloua curtipendula)*, little bluestem, and many others (Kennedy et al. 2010).	This community has been found in the south central portion of Colorado.
	Populus angustifolia Sand Dune Forest	Arizona/New Mexico Plateau	An unusual woodland found on braided, sandy streams adjacent to wind-driven, actively moving sand dunes at 7,545 feet in elevation in south-central Colorado. Narrowleaf cottonwood dominates the overstory and are found atop sand dunes without any shrub or herbaceous layers (Western Ecology Group 1998a).	This community has been found in the south central portion of Colorado.
	Populus angustifolia/ Salix drummondiana - Acer glabrum Woodland	Southern Rockies	A lush, deciduous, riparian woodland community found on alluvial floodplains in southern Colorado at elevations of 5,905 to 6,581 feet (1,800 to 2,000 m). The overstory is sparse to dense and comprised of narrowleaf cottonwood and Drummond's willow *(Salix drummondiana)*, and scattered Rocky Mountain maple. The shrub layer is comprised of Wood's rose, gray alder, fivepetal cliffbush *(Jamesia americana)*, shining willow *(Salix lucida)*, and chokecherry (Western Ecology Group 1998b).	This community has been found in the central portion of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
Plains Cottonwood/ Alkali Muhly	*Populus deltoides/ Muhlenbergia asperifolia* Forest	Unknown	A riparian woodland occurring in lowland river valleys on mid- to upper-elevation bars and terraces within active floodplains in along the Arkansas River in Colorado from 3,850 to 5,500 feet. The overstory is dominated by older, open stands of Rio Grande cottonwood *(Populus deltoides* ssp. *wislizeni)* or plains cottonwood *(Populus deltoides* ssp. *monilifera).* Invasive species tamarisk *(Tamarix spp.)* and Russian olive *(Elaeagnus angustifolia)* are often abundant. The understory is dominated by scratchgrass *(Muhlenbergia asperifolia)* (Muldavin 1997).	The distribution of this community is unknown.
Plains Cottonwood/ Rough Dropseed	*Populus deltoides/ Sporobolus asper* Forest	Unknown	A forest community found within the Western Great Plains Big River Floodplain system. This system encompasses floodplains of medium to large rivers in the Western Great Plains, and in Colorado includes the South Platte and Arkansas Rivers. Associations within this system range from floodplain forests to wet meadows and all have similar soils and flooding regimes. Dominant species in associations within the system include eastern cottonwood and willow species (CNHP 2005b).	The distribution of this community is unknown.
Upper Montane Woodlands	*Pinus aristata/ Ribes montigenum* Woodland	Southern Rockies	A woodland community found on scree and cobbly soils in northern Arizona, northern New Mexico, and Colorado at elevations of 10,000 to 11,500 feet. Overall, species diversity is low in this community. The tree canopy is dominated by bristlecone pine *(Pinus artistata)* with some Engelmann spruce intermixed. Mountain gooseberry *(Ribes montigenum)* dominates the shrub layer and low abundance of common juniper *(Juniperus communis)* (Kettler 1997).	This community has been found in the central portion of Colorado.
Western Slope Ponderosa Pine Woodlands	*Pinus ponderosa/ Achnatherum hymenoides* Sparse Vegetation	Unknown	A sparse woodland found in the lower foothills of the Southern Rocky Mountains at elevations of 8,040 to 8,525 ft (2,453 to 2,600 m). This association is typically found on gently sloping landscapes that are southerly or westerly. Ponderosa pine is the dominant tree species. A sparse shrub layer may be present with rubber rabbitbrush, frosted mint (*Poliomintha incana*), and mountain mahogany	The distribution of this community is unknown.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			(*Cercocarpus montanus*). The herbaceous strata ranges from five to 20 percent coverage with Indian ricegrass, spike dropseed (*Sporobolus contractus*), sand bluestem (*Andropogon hallii*), and sandhill muhley (*Muhlenbergia pungens*) present (Reid & Schulz 2010).	
	Pinus ponderosa/ Arctostaphylos patula Woodland	Colorado Plateau	A woodland community found in mountains and plateaus on dry, warm, mid to lower slopes, benches and ridges often with southerly aspects. This community is found in Colorado, Utah, and California at 5,800 to 8,500 feet. The open tree canopy is typically dominated by ponderosa pine and the shrub layer is dominated by greenleaf manzanita *(Archtostaphylos patula).* The herbaceous layer is sparse and is primarily composed of graminoids. Common species in this layer include Ross' sedge *(Carex rossii),* Indian ricegrass, squirreltail *(Elymus elymoides),* Salina wildrye *(Leymus salinus),* and muttongrass (Schulz & Coles 2005).	This community has been found on the western border of Colorado and Utah.
Grasslands/Herbaceous				
Great Plains Mixed Grass Prairie	*Andropogon hallii - Carex inops* ssp. *heliophila* Herbaceous Vegetation	Southwestern Tablelands	A prairie community found on gently to steeply sloping terrain, on choppy sand dune habitat. Vegetation coverage is approximately 15 to 50%. Sand bluestem dominates the taller herbaceous stratum. Sun sedge *(Carex inops* ssp. *heliophila)* and other Carex *sp*. dominate the lower herbaceous stratum (Drake 1995b).	This community has been found in the eastern portion of Colorado.
Loess Prairie	*Schizachyrium scoparium - Bouteloua curtipendula Loess* Mixedgrass Herbaceous Vegetation	High Plains, Southwestern Tablelands	A mixedgrass prairie community found on level to steep uplands, and is dominated by short to mid grasses, but tall grasses are scattered on lower slopes. This community is found in the northern Great Plains on deep or silt loam. Little bluestem is more dominant on steeper slopes and sideoats grama *(Bouteloua curtipendula)* is dominant on gentler slopes. Other species that may be present include big bluestem *(Andropogon gerardii),* switchgrass *(Panicum virgatum),* and western wheatgrass among many others (Drake & Rolfsmeier 1997).	This community has been found in the eastern portion of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
Montane Grasslands	*Festuca idahoensis - Elymus trachycaulus* Herbaceous Vegetation	Colorado Plateau, Southern Rockies	A grassland community that occurs on high mountain slopes and alluvial terraces in Montana, Colorado, and Wyoming at 3,600 to 10,900 feet. This community contains four to 13% bare ground and up to 40 % litter, high diversity, and 30 to 70% forb cover. Dominant grass species include slender wheatgrass *(Elymus trachycaulus)* and Idaho fescue *(Festuca idahoensis).* Additional grass species are present. Forbs that are abundant within the community include old man's whiskers (*Geum triflorum*), slender cinquefoil *(Potentilla gracilis),* common yarrow *(Achillea millefolium)*, sticky purple geranium *(Geranium viscosissimum),* pale agoseris *(Agoseris glauca),* and bluebell bellflower *(Campanula rotundifolia)* (Kittel 2004a).	This community has been found in the western half of Colorado.
	Pseudoroegneria spicata - Poa secunda Herbaceous Vegetation	Colorado Plateau, Southern Rockies	A bunch grassland community found on slopes and ridges, alluvial fans, scree slopes, rocky cliff faces, and bedrock outcrops on the edge of basins and foothills primarily on southerly or westerly aspects. This community can be found at montane or subalpine elevations in Washington, Oregon, Idaho, Utah, Colorado, Wyoming, and Montana. Graminoids dominate with little cover of forbs and shrubs. Bluebunch wheatgrass *(Pseudoroegneria spicata)* dominates or codominates, and Sandberg bluegrass and junegrass *(Koeleria macrantha)* are typically present in significant quantities (Coles & Schulz 2008b).	This community has been found in the northern and western parts of Colorado.
No common name	*Achnatherum hymenoides - Psoralidium lanceolatum* Herbaceous Vegetation	Southern Rockies, Arizona/New Mexico Plateau	An herbaceous community found on dunefields and sandsheets that are generally flat to slightly rolling and are sparsely vegetated (<30%). This community is found in Colorado, Utah, Idaho, and Montana at 7,611 to 7,726 feet. Indian ricegrass dominates or codominates with lemon scurfpea *(Psoralidium lanceolatum).* Rubber rabbitbrush may also be present in low densities along with various other forbs and graminoids (Sabo et al. 2010).	This community has been found in the south-central portion of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Hesperostipa comata - Achnatherum hymenoides Herbaceous Vegetation	Southern Rockies, Arizona/New Mexico Plateau	A grassland community that develops on benches, plateaus, and ridges with gentle to moderately steep slopes. This community tends to form in small to medium-sized patches within recently burned sagebrush shrublands and can be found in western Colorado, northeastern Utah, and south-central Wyoming at elevations of 5,085 to 9,015 feet. Indian ricegrass and needle and thread grass *(Hesperostipa comata)* dominate and western wheatgrass and squirreltail may also be present. Scattered shrubs, including big Wyoming sagebrush *(Artemesia tridentata* ssp. *wyomingensis),* winterfat *(Kraschenninikovia lanata),* broom snakeweed *(Gutierrezia sarothrae),* and rubber rabbitbrush may also be present. Forbs are also present in moderate density and include spiny phlox *(Phlox hoodii),* alpine golden buckwheat *(Eriogonum flavum),* and scarlet globemallow *(Sphaeralcea coccinea)* (Jones & Coles 2005).	This community has been found in the south-central portion of Colorado.
	Juniperus osteosperma/Hesperostipa comata Wooded Herbaceous Vegetation	Colorado Plateau	An herbaceous community found in cool, arid conditions on lower, relatively steep slopes. This community can be found at elevations of 5,200 to 6,700 feet. Limited information is available on the community composition for this association. Utah juniper *(Juniperus osteosperma)* dominates the open canopy layer and needle and thread grass is abundant in the understory (Reid & Rust 1993).	This community has been found in the west-central portion of Colorado.
	Redfieldia flexuosa - (Psoralidium lanceolatum) Herbaceous Vegetation	Southern Rockies, Arizona/New Mexico Plateau	An herbaceous community found on sparsely vegetated, wind-shifted active sand dunes. This community can be found in the San Luis Valley of Colorado at 6,000 to 7,800 feet. In the wind-swept areas of the association, blowout grass *(Redfieldia flexuosa)* is commonly the only species present at very low densities (2 to 10%) but lemon scurfpea may also be present and codominate (Rondeau 2001).	This community has been found in the eastern and southern parts of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Utricularia macrorhiza Herbaceous Vegetation [Provisional]	Southern Rockies	An aquatic bed community with lakes, ponds, and a source of perennial waters. Common bladderwort (*Utricularia macrorhiza*) is an insectivorous plant that forms dense, monotypic stands that cover 40 to 95 percent of the strata. The community may favor eutrophic conditions or could be enhanced with agricultural and urban landscape influence (Christy 2004).	This community has been found in the north-central part of Colorado.
Playa Grassland	*Pascopyrum smithii - Eleocharis spp.* Herbaceous Vegetation	High Plains, Southwestern Tablelands, Southern Rockies	An herbaceous community that grows in periodically inundated, small playas. Dominant species include western wheatgrass and rush species *(Eleocharis spp.)*, primarily *(Eleocharis acicularis)* and common spikerush *(Eleocharis palustris)*. Other species present include meadow barley *(Hordeum brachyantherum)*, Baltic rush *(Juncus balticus)*, and foxtail grasses *(Alopecurus spp.)* (Jones 1997).	This community has been found in central and eastern parts of Colorado.
Slimstem Reedgrass	*Calamagrostis stricta* Herbaceous Vegetation [Provisional]	Southern Rockies, Arizona/New Mexico Plateau	A forest community found within the Rocky Mountain Alpine-Montane Wet Meadow system. This system is found at high elevations, from montane to alpine areas. Typically, associations within this system are found on flat to gently sloping areas with slow-flowing surface and subsurface waters (Kagan et al. 2006).	This community has been found in the north and south central parts of Colorado.
Western Slope Grasslands	*Pleuraphis jamesii* Herbaceous Vegetation	Colorado Plateau	A grassland community found on alluvial flats, plateau parks, mesas and plains that can be as small as woodland parks or more extensive grasslands on the plains. The herbaceous layer is sparse to moderately dense and is strongly dominated by the warm-season bunchgrass James' galleta *(Pleuraphis jamesii)*. Other species present include Indian ricegrass, black grama, blue grama, needle and thread grass, bush muhly *(Muhlenbergia porter)*, alkali sacaton *(Sporobolus airoides)*, or sand dropseed (*Sporobolus cryptandrus*). The presence of forbs is sparse and includes species of Plantago, Gilia, Lappula, and prickly pear cacti *(Opuntia spp.)*. A shrub layer is not present due to the insignificant amount of shrubs and dwarf-shrubs (Schulz et al. 2008)	This community has been found in the western part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Pseudo-roegneria spicata - Bouteloua gracilis Herbaceous Vegetation	Southern Rockies	A grassland community found at low elevations, on toeslopes of the foothills and steeper slopes of valley bottoms. Vegetation is open and is dominated by needle and thread grass and bluebunch wheatgrass *(Pseudoroegneria spicata).* Blue grama is also present but is not considered a dominant species. Other herbaceous species present include needleleaf sedge *(Carex duriuscula),* junegrass *(Koeleria macrantha*), and Sandberg bluegrass *(Poa secunda),* fringed sage, spiny phlox *(Phlox hoodia),* and scarlet globemallow *(Sphaeralcea coccinea).* The shrub layer is less than 10% and may include rubber rabbitbrush, broom snakeweed, and plains prickly pear *(Opuntia polyacantha)* (Cooper 1999).	This community has been found in the north-central part of Colorado.
Whip- root clover	*Trifolium dasyphyllum* ssp. *Anemophilum* Herbaceous Vegetation	Southern Rockies	An herbaceous plant community dominated by whip-root clover (*Trifolium dasyphyllum* ssp. *Anemophilum*). The Alpine Clover Herbaceous Vegetation (*Trifolium dasyphyllum* Herbaceous Vegetation) association is very similar and can be found in the alpine regions of the southern Rocky Mountains of Colorado on gentle to steep slopes. Whip-root clover is the dominant herbaceous plant (Schulz 2005).	This community has been found in the southern Rocky Mountains.
Shrublands				
Alpine Scrub	*Vaccinium (caespitosum, scoparium)* Dwarf - shrubland	Southern Rockies	A dwarf-shrub community that occurs near treeline in mountains and is often found on gentle to steep slopes. This community is found in northern Colorado and northwestern Wyoming. A moderate to dense layer of either dwarf bilberry and/or grouse whortleberry characterizes this community. Herbaceous species vary greatly in this association and may include American bistort *(Polygonum bistortoide),* timber oatgrass *(Danthonia intermedia),* creeping sibbaldia *(Sibbaldia procumbens),* Whipple's penstemon *(Penstemon whippleanus),* Cusick's bluegrass *(Poa cusickii),* Pyrenean sedge *(Carex pyrenaica),* Ross' avens *(Geum rossii),* subalpine fleabane *(Erigeron peregrinus),* white marsh marigold	This community has been found in the north-western part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			(Caltha leptosepala), and Drummond's rush *(Juncus drummondii)* (Coles 2005).	
Desert Shrubland	*Nolina texana* Shrubland	Southwestern Tablelands	A shrubland community dominated by Texas sacahuista (*Nolian texana*). Texas sacahista can typically be found in openings within woodlands and on woodland edges in rocky soils (Native Plant Database [NPD] 2015).	This community has been found in the south-eastern part of Colorado, near the Colorado-New Mexico border.
Gardner's Mat Saltbush Shrublands	*Atriplex gardneri/ Pleuraphis jamesii* Dwarf - Shrubland	Colorado Plateau	A dwarf-shrubland community that occurs on barren shale slopes and flats with sparse vegetation. Gardner's saltbush *(Atriplex gardneri)* is comprised of most of or the entire shrub layer. In the sparse herbaceous layer, James' galleta is prominent, and Indian ricegrass and Sandberg bluegrass may also be present (Coles & Schulz 2007).	This community has been found in the western part of Colorado.
Foothills Riparian Shrubland	*Shepherdia argentea* Shrubland	Colorado Plateau, Southern Rockies, Wyoming Basin	A mesic shrubland community that occurs in areas where moisture is concentrated compared to the surrounding landscape. This community can be found on stream terraces, rolling uplands, badlands, and near ravines, streams and ditches, and on northwest- to east-facing slopes. It has been documented in the northern Great Plains and on the western slope of Colorado. The shrub canopy is moderate- to densely-covered with medium-tall shrubs, with silver buffaloberry *(Shepherdia argentea)* being dominant. The herbaceous layer is about half as dense as the shrub layer and contains various forbs and graminoids, some of which are Kentucky bluegrass, western wheatgrass, Pennsylvania pellitory *(Parietaria pensylvanica),* and common yarrow (Drake et al. 2009).	This community has been found scattered throughout the western half of Colorado.
	Forestiera pubescens Shrubland	Colorado Plateau	A shrubland community found in canyon bottoms, floodplains, sandy terraces near major rivers, and washes on the outer edges of the active floodplain. It has been documented in southwestern Colorado, northeastern Arizona, and southeastern Utah at 4,400 to 5,500 feet. The shrub layers is often densely dominated by stretchberry *(Forestiera pubescens)* with greasewood, rubber rabbitbrush, and skunkbush sumac (Tasker & Schulz 2007).	This community has been found in the western part of Colorado, near the Colorado-Utah border.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
Mixed Foothill Shrublands	*Artemisia tripartita* ssp. *tripartita/ Festuca idahoensis* Shrub/ Herbaceous Vegetation	Southern Rockies	A mixed shrubland-herbaceous community found at elevations of 6,000 to 8,000 ft (2,000 to 2,700 m) on gently sloping areas with moderately deep soils. Tall three-tip sagebrush dominates the overstory and shrub layer, while Idaho fescue is the predominant plant in the herbaceous layer. Other shrubs present include green rabbitbrush (*Chrysothamnus viscidiflorus*), gray horsebrush (*Tetradymia canescens*), and fringed sagewort (*Artemisia frigida*). In the herbaceous stratum, prairie junegrass (*Koeleria pyramidata*), plains reedgrass, hood phlox (*Phlox hoodii*), rose pussytoes (*Antennaria rosea*), and silky lupine (*Lupinus sericeus*) (Shiflet 1994).	This community has been found in the north-central part of Colorado, near the Colorado-Wyoming border.
No common name	*Baccharis salicina* Shrubland	Unknown	A shrubland community typically found near streams and lakes, commonly on the first terrace and on alluvial soils. This community is found in areas with high water tables and seasonal flooding. Vegetation in this community is usually short, but some taller shrubs and trees are present. The short shrub canopy is dominated by willow baccharis *(Baccharis salicina)*, but also may contain willows *(Salix spp.)*, salt cedar *(Tamarix spp.)*, and eastern cottonwood *(Populus deltoides)*. The sparse to moderate herbaceous layer contains scratchgrass, switchgrass, and common reed *(Phragmites australis)* (Drake 2005).	The distribution of this community is unknown.
Sagebrush Bottomland Shrublands	*Artemisia tridentata* ssp. *tridentata/Leymus cinereus* Shrubland	Colorado Plateau, Wyoming Basin	A shrubland community associated with floodplains, perennial stream terraces, high desert steppe seasonally flooded wash or gully edges, or mesic upland swales with high water tables and at elevations of 5,250 to 7,120 feet. This association is characterized by the shrub layer being dominated by mountain big sagebrush *(Artemisia tridentata* ssp. *tridentata)* with some rubber rabbitbrush and greasewood. The herbaceous layer is dominated by basin wildrye *(Leymus cinereus)* (Jankovsky-Jones et al. 2008).	This community has been found scattered throughout the northwestern part of Colorado.
Skunkbush-Little Leaf Mock Orange Shrubland	*Rhus trilobata - Philadelphus microphyllus* Shrubland	Southwestern Tablelands	A shrubland community found within the Southwestern Great Plains Canyon system. This system is associated with canyons with perennial and intermittent	This community has been found in the southeastern part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			streams in the southwestern Great Plains. This system I characterized by a unique combination of varied geology, soil diversity, and topography. Associations within this system typically contain (*Juniperus monosperma*) as the dominant tree species (CNHP 2005c). Skunkbush sumac (*Rhus trilobata*) and littleleaf mockbush (*Philadelphus microphyllus*) are dominant species.	
Western Slope Sagebrush Shrublands	*Artemisia tridentata* ssp. *wyomingensis/ Elymus albicans* Shrubland	Wyoming Basin	A shrubland community found within the Inter-Mountain Basins Big Sagebrush Shrubland system. This system is associated with dense taller *Artemesia* species and a prominent herbaceous stratum (CNHP 2005d). Dominant species for this association include Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis)* and Montana wheatgrass (*Elymus albicans*) (CNHP 2005d).	This community has been found in the northwestern part of Colorado.
Wetland and Riparian				
Alpine Wetlands	*Carex vernacula* Herbaceous Vegetation	Southern Rockies	A wetland community typically found on gently sloping, glaciated, alpine basins along narrow and sinuous stream channels. The herbaceous layer is dominated by native sedge *(Carex vernacula).* Marsh marigold and tufted hairgrass *(Deschampsia cespitosa)* may also be present or co-dominate (Western Ecology Group 1997).	This community has been found in the southwestern part of Colorado.
Aspen Wetland Forests	*Populus tremuloides/ Senecio bigelovii* var. *bigelovii* Forest	Unknown	A wetland community that occurs on cool, moist gently sloping east-, west-, or northeast-facing swales. It has been documented in the Front Range of Colorado at 8,600 to 9,040 feet. Quaking aspen dominates the overstory, but white fir, blue spruce, lodgepole pine, and Douglas fir are also present. The shrub layer is comprised of Wood's rose, kinnikinnick, and common juniper *(Juniperus communis).* The herbaceous layer is primarily comprised of forbs but also contains some graminoids. Nodding ragwort *(Senecio bigelovii* var. *bigelovii)* is always present within the herbaceous strata (Rondeau 1997).	The distribution of this community is unknown.
Extreme Rich Fens	*Kobresia myosuroides - Thalictrum alpinum*	Southern Rockies	A rich fen community found in small patches and are localized to specific environments by groundwater discharge, soil chemistry, and peat accumulation.	This community has been found in the central part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Herbaceous Vegetation		The community is formed in depressional, low areas near the interface of groundwater and soil surface in areas with waters containing high magnesium and calcium. This community has been documented in South Park, Colorado at 9,440 to 9,760 feet. Alpine meadow-rue *(Thalictrum alpinum)* is always present in this community. Bellardi bog sedge *(Kobresia myosuroides)* is often present. Other plants that are associated with this community include shortfruit willow *(Salix brachycarpa)*, Porter's false needlegrass *(Ptilagrostis porteri),* arctic rush *(Juncus arcticus),* and simple bog sedge *(Kobresia simpliciuscula)* (Western Ecology Group 2001a).	
	Kobresia simpliciuscula - Trichophorum pumilum Saturated Herbaceous Vegetation	Southern Rockies	A rich fen community found in small patches and are localized to specific environments by groundwater discharge, soil chemistry, and peat accumulation. The community is formed in depressional, low areas near the interface of groundwater and soil surface in areas with waters containing high magnesium and calcium. This community has been documented in South Park, Colorado at 8,960 to 10,040 feet. The presence of simple bog sedge and Rolland's bulrush *(Trichophorum pumilum)* characterize this community. Other plants that are associated with this community include alpine meadow-rue, Bellardi bog sedge, arctic rush, and sageleaf willow *(Salix candida)* (Western Ecology Group 2001b).	This community has been found in the central part of Colorado.
Fremont's Cottonwood-Gooding's Black Willow	*Populus fremontii - Salix gooddingii* Woodland	Colorado Plateau	A woodland community that is dependent upon subsurface water availability, and often parallels stream channels. Disturbances such as major flood events, flood scour, deposition of water and sediment on stream banks, and natural stream meandering all play a role in the presence of this community. Fremont's cottonwood and Goodding's willow *(Salix gooddingii)* may individually dominate or codominated. The herbaceous layer varies in content, but contains mixed annuals and short-lived perennials (Milford et al. 2005).	This community has been found in the southwestern part of Colorado, near the Colorado-Utah border.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
Great Plains Floating/Submergent Palustrine Wetlands	*Potamogeton diversifolius* Herbaceous Vegetation	Unknown	A wetland community found within the North American Arid West Emergent Marsh system. This system may be found near ponds, kettle ponds, lake fringes, slow-flowing rivers and streams, seeps, and springs. Plant species in this system are adapted to saturated soils and include emergent and floating vegetation (CNHP 2005e). Waterthread pondweed (*Potamogeton diversifolius)* is a dominant species in this association (CNHP 2005e).	The distribution of this community is unknown.
Montane Riparian Meadow	*Carex foenea* Herbaceous Vegetation	Unknown	A meadow community dominated by straw sedge (*Carex foenea*). Straw sedge is typically found on cliff ledges, meadows, fields, woodlands, and some disturbed habitats (Go Botany 2015).	The distribution of this community is unknown.
Montane Floating/Submergent Wetland	*Potamogeton natans* Herbaceous Vegetation	Southern Rockies	An aquatic community found in ponds, pools, lakes, and sloughs that forms aquatic, floating mats on the surface of waters. Floating pondweed *(Potamogeton natans)* is the dominant species but common bladderwort *(Utricularia macrorhiza)*, Rocky Mountain pond-lily *(Nuphar polysepala)*, and watershield *(Brasenia schreberi)* may also be present in sizable mats (Christy 2006).	This community has been found in the north-central part of Colorado.
Montane Wet Meadows	*Deschampsia caespitosa - Carex nebrascensis* Herbaceous Vegetation	Unknown	A herbaceous wet meadow community dominated by tufted hairgrass (*Deschampsia caespitosa)* and Nebraska sedge (*Carex nebrascensis)*. A similar vegetation community, Tufted Hairgrass Meadow, is found on the periphery of wetlands and in wet alpine meadows at elevations of 2,625 to 11,650 ft (800 to 3,550 m). Snowmelt as a source of water and spring and summer saturation is essential to this vegetation community (Kittel & Schulz 2005).	The distribution of this community is unknown.
Montane Wetland	*Carex lasiocarpa* Herbaceous Vegetation	Arizona/ New Mexico Plateau, Southern Rockies	A peatland community found in low-gradient, wide valleys, and depressional areas that are seasonally flooded with low to poor drainage and remain saturated year-round. This community can be found in Washington, Montana, Utah, and Colorado at 1,900 to 9,800 feet. Associated species are low in diversity and include dominant woolyfruit sedge *(Carex lasiocarpa)* and water sedge *(Carex aquatilis)*, Northwest	This community has been found in the north-central part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
			territory sedge *(Carex utriculata)*, silvery sedge *(Carex canescens)*, smallwing sedge *(Carex microptera)*, Buxbaum sedge *(Carex buxbaumii)*, Rocky Mountain pond-lily, yellow pond-lily *(Nuphar variegata)* (Kittel 2004b).	
	Carex vesicaria Herbaceous Vegetation	Southern Rockies	A wetland community found near the edges of slow moving streams and reaches, beaver ponds, montane lakes, and swales or overflow channel floodplains. This community is found in the western U.S. at 3,535 to 9,500 feet. Blister sedge *(Carex vesicaria)* is the dominant species but various other forbs and graminoids may be present. Other species include Baltic rush, tufted hair-grass *(Deschampsia caespitosa)*, Nebraska sedge *(Carex nebrascensis)*, common spikerush, threepetal bedstraw *(Galium trifidum)*, small camas *(Camassia quamash)*, and field horsetail *(Equisetum arvense)* (Keeler-Wolf & Kittel 2004).	This community has been found scattered throughout the central part of Colorado.
Peachleaf Willow Alliance	*Salix amygdaloides* Woodland	Southwestern Tablelands	A willow woodland found in isolated clumps in riparian zones of backwaters, overflow channels of large rivers, narrow floodplains of small creeks, and on the periphery of ponds and lakes. This community has been found in the northern Rocky Mountains into the western Great Plains. Peachleaf willow *(Salix amygdaloides)* is the dominant vegetation (Kittel & Allen 2006).	This community has been found in the central part of Colorado.
Plains Cottonwood Riparian Woodland	*Populus deltoides - (Salix nigra)/ Spartina pectinata - Carex spp.* Woodland	High Plains	A cottonwood-willow woodland found in deep sandy loam to sand poorly drained soils with high water tables. This community can be found near the lower Missouri River and its tributaries. The overstory is comprised of box elder, pecan *(Carya illinoinensis)*, green ash *(Fraxinus pennsylvanica)*, eastern cottonwood, pin oak *(Quercus palustris)*, black willow *(Salix nigra)*, and American elm *(Ulmus americana)*. The herbaceous layer includes tall and mid grasses and forbs, some of which include big bluestem, switchgrass, and prairie cordgrass *(Spartina pectinata)* (Drake et al. 1994).	This community has been found in the northeastern part of Colorado.

Vegetative Community Type Common Name	Vegetative Community Type Scientific Name(s)	EPA Ecoregion(s)	Description	Distribution
	Populus deltoides/ Carex pellita Woodland	High Plains, Southwestern Tablelands	A cottonwood woodland community found along braided channels in swales with clayey soils. It can be found in the lower South Platte River in northeastern Colorado. Older eastern cottonwoods are dominant in the tree layer, and wooly sedge *(Carex pellita)* is the dominant herbaceous species (Western Ecology Group 1998c).	This community has been found scattered throughout the northeastern and southeastern parts of Colorado.
Western Slope Marsh	*Typha domingensis* Herbaceous Vegetation	Colorado Plateau	A widespread, wetland community found below seeps, in river floodplain depressions, around oxbow lakes, and in bottomlands along drainages in fine-textured, alkaline, alluvial soils. The herbaceous layer is defined by dense southern cattail *(Typha domingensis)* dominating or co-dominating with hardstem bulrush *(Schoenoplectus acutus).* Additionally, various forbs, graminoids, and aquatic plants may be present (Reid & Schulz 2001).	This community has been found in the northwestern part of Colorado.
Western Slope Salt Meadows	*Salicornia rubra* Herbaceous Vegetation	Southern Rockies, Arizona/New Mexico Plateau	A community found near alkaline wetlands or semipermanent alkaline lakes, where it borders open water or is on exposed alkali mud flats. The dominant species is red swampfire *(Salicornia rubra)*, which may make up to 100% of the cover. Other associated species are Nuttall's alkaligrass *(Puccinellia nuttalliana)*, saltgrass *(Distichlis spicata)*, foxtail barley *(Hordeum jubatum)*, seaside arrowgrass *(Triglochin maritima)*, red goosefoot *(Chenopodium rubrum)*, and purse seepweed *(Suaeda calceoliformis)* (Lenz & Allen 2006).	This community has been found in the south central parts of Colorado.
West Slope Riparian Woodland	*Fraxinus anomala/ Quercus gambelii* Woodland	Colorado Plateau	A riparian woodland community found near seeps, springs, and seasonal streams at elevations of 4,700 to 6,700 ft (1,430 to 2,043 m). Singleleaf ash (*Fraxinus anomala*) and Gambel's oak (*Quercus gambelii*) dominate and western serviceberry (*Amelanchier alnifolia*) may also codominate. The shrub layer is sometimes present and sparsely distributed. Species that could be present in the shrub layer include skunkbush sumac (*Rhus trilobata*), rockspirea (*Holodiscus dumosus)*, and rubber rabbitbrush (Kittel et al. 2005).	This community has been found in the western part of Colorado.

Source: (CNHP, 2015).

ACRONYMS

Acronym	Definition
AARC	Average Annual Rate of Change
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
ADCOM	Adams County Communications Center, Inc.
AGL	Above Ground Level
AIM	Aeronautical Information Manual
AML	Abandoned Mine Lands
APCD	Air Pollution Control Division
APE	Area of Potential Effect
APEN	Air Pollutant Emission Notice
AQCR	Air Quality Control Region
ARPA	Archaeological Resources Protection Act
ASL	Above Sea Level
ASPM	Aviation System Performacne Metrics
ATC	Air Traffic Control
ATO	Air Traffic Organization
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
BTOP	Broadband Technology Opportunities Program
CAA	Clean Air Act
CAAQS	Colorado Ambient Air Quality Standards
CAB	Colorado Aeronautics Board
CBOCES	Centennial Board of Cooperative Educational Services
CCD	Common Core of Data
CCNC	Communications Network of Colorado
CDA	Colorado Department of Agriculture
CDLE	Colorado Department of Labor and Employment
CDOT	Colorado Department of Transporation
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health & Environment
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH_4	Methane
CIMC	Cleanups in My Community
CIO	Chief Information Officer
CNAP	Colorado Natural Areas Program
CNHP	Colorado Natural Heritage Program
CO	Colorado; Carbon Monoxide
CO2	Carbon Dioxide
COLT	Cell On Light Trucks
COS	Colorado Springs Municipal Airport
COW	Cell On Wheels
CPW	Colorado Parks and Wildlife
CRS	Colorado Revised Statute
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board

Acronym	Definition
CWS	Community Water Systems
DEN	Denver International Airport
DOE	Department of Energy
DTRS	Digital Trunk Radio System
EDACS	Enhanced Digital Access System
EFH	Essential Fish Habitat
EIA	Energy Information Agency
EMS	Emergency Medical Services
EO	Executive Order
EPCRA	Emergency Planning and Community Right to Know Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FCC	Federal Communication Commission
FEMA	Federal Emergency Management Agency
FGDC	Federal Geographic Data Committee
FHWA	Federal Highways Administration
FLM	Federal Land Manager
FLPMA	Federal Land Policy and Management Act of 1976
FR	Federal Register
FRA	Federal Railroad Administration
FTA	Federal Transit Authority
FSDO	Flight Standards District Offices
FSS	Flight Service Station
GAO	Government Accountability Office
GAP	Gap Analysis Program
GHG	Greenhouse Gas
HAP	Hazardous Air Pollutant
HASP	Health and Safety Plans
HHRA	Human Health Risk Assessment
IBA	Important Birding Area
IFR	Instrument Flight Rules
IPCC	Intergovernmental Panel On Climate Change
LBS	Locations-Based Services
LCCS	Land Cover Classification System
LID	Low Impact Development
LMR	Land Mobile Radio
LRR	Land Resource Regions
LTE	Long Term Evolution
M&I	Municipal and Industrial
MAC	Mutual Aid Channel
MARC	Metro Area Radio Cooperative
MBTA	Migratory Bird Treaty Act
MDI	Methylene Diphenyl Diisocyanate
MHI	Median Household Income
MLRA	Major Land Resource Areas
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
MMT	Million Metric Tons
MSFCMA	Magnuson-Stevens Fisheries Conservation Management Act
MSL	Mean Sea Level
MT	Million Tons

Acronym	Definition
MYA	Million Years Ago
N_2O	Nitrous Oxide
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAICS	North American Industry Classification System
NAS	National Airspace System
NCA	National Conservation Areas
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 Institute of Health
NIST	National Institute of Standards and Technology
NM	Nautical Miles
NNL	National Natural Landmarks
NOAA	National Oceanic and Atmospheric Administration
NOTAM	Notices To Airmen
NO_X	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NPSBN	Nationwide Public Safety Broadband Network
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSA	National Security Areas
NTFI	National Task Force on Interoperability
NTIA	National Telecommunications and Information Administration
NTNC	Non-Transient Non-Community
NWI	National Wetlands Inventory
NWR	National Wildlife Refuges
NWS	National Weather Service
OCIO	Office of the CIO
ODS	Ozone Depleting Substance
OE/AAA	Obstruction Evaluation and Airport Airspace Analysis
OIT	Office of Information Technology
OSHA	Occupational Safety and Health Administration
OTR	Ozone Transport Region
PAB	Palustrine Aquatic Bed
PEIS	Programmatic Environmental Impact Statement
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
PGA	Peak Ground Acceleration
PM	Particulate Matter
POP	Points of Presence
PPE	Personal Protective Equipment
PSAP	Public Safety Answering Point
PSCR	Public Safety Communications Research
PSCS	Public Safety Communications Subcommittee

Acronym	Definition
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub-Shrub Wetland
PUB	Palustrine Unconsolidated Bottom
PUC	Public Utilities Commission
R&D	Research and Development
RACOM	Radio Communications
RCRA	Resource Conservation and Recovery Act
RF	Radio Frequency
ROW	Right-of-Way
RTD	Regional Transportation District
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
SDWA	Safe Drinking Water Act
SF_6	Sulfur Hexafluoride
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SO2	Sulfur Dioxide
SO3	Sulfur Trioxide
SOC	Standard Occupational Classification
SOP	Standard Operating Procedures
SOW	System On Wheels
SOX	Oxides of Sulfur
SPL	Sound Pressure Level
SRS	Statewide Radio System
SUA	Special Use Airspace
SWAP	State Wildlife Action Plan
SWPPP	Storm Water Pollution Prevention Plan
THPO	Tribal Historic Preservation Office
TMDL	Total Maximum Daily Load
TNC	Transient Non-Community Systems
TPY	Tons Per Year
TRI	Toxics Release Inventory
TSCA	Toxic Substances Control Act
TWA	Time Weighted Average
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UHF	Ultra High Frequency
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of Interior
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey

Acronym	Definition
VFR	Visual Flight Rules
VHF	Very High Frequency
VOC	Volatile Organic Compounds
WMA	Wildlife Management Areas
WMD	Wetland Management District
WONDER	Wide-Ranging Online Data For Epidemiologic Research
WWI	World War I
WWII	World War II

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