U.S. Department of the Interior
BUREAU OF LAND MANAGEMENT

April 2020

Draft Programmatic EIS for Fuels Reduction and Rangeland Restoration in the Great Basin

Volume 1: Executive Summary, Chapters 1 through 5

Estimated Lead Agency Total Costs Associated with Developing and Producing this EIS

$2,000,000

The Bureau of Land Management's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

United States Department of the Interior
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MAR 26 2020

In Reply Refer To:
1793 (930)

Dear Reader:

Enclosed for your review and comment is the Draft Programmatic Environmental Impact Statement (Draft PEIS) for Fuels Reduction and Rangeland Restoration in the Great Basin. This Draft PEIS was prepared by the Bureau of Land Management (BLM) and analyzes the direct, indirect, and cumulative impacts of conserving and restoring sagebrush communities in the Great Basin.

The Project Area covers approximately 223 million acres, including portions of California, Idaho, Nevada, Oregon, Utah, and Washington. Restoration projects would be implemented on portions of the 38.5 million acre analysis area of sagebrush communities managed by the BLM within the Project Area boundary. The analysis area is defined by the current and historical presence of sagebrush on BLM-administered lands. The preferred alternative (Alternative B) analyzes a full suite of manual, chemical and mechanical restoration treatments, including prescribed fire, seeding, and targeted grazing. The BLM considered four alternatives in detail and an additional three alternatives that were not analyzed in detail because they did not adequately respond to the purpose and need for the PEIS. This Draft PEIS complements the Department of the Interior's proposed Categorical Exclusion for the removal of encroaching Pinyon-Juniper trees as it addresses additional restoration activities.

Public Comments on the Draft PEIS will be accepted during a 60-day public comment period that begins when the Notice of Availability (NOA) is published in the Federal Register. You may submit comments related to the Draft PEIS for Fuels Reduction and Rangeland Restoration in the Great Basin by any of the following methods:

- Website: https://go.usa.gov/xdfgV
- Email: BLM_PEIS_Comments@blm.gov
- Fax: 208-373-3805
- Mail: Bureau of Land Management, Idaho State Office, ATTN: Fuels Reduction Draft PEIS, 1387 South Vinnell Way, Boise, ID 83709

Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment (including your personal identifying information) may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Following the comment period, a Final PEIS will be prepared. The BLM appreciates your interest in the management of public lands. If you would like further information on this project questions can be directed to Ammon Wilhelm, Project Manager, (208) 373-3824.

Sincerely,

John F. Ruhs
State Director

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Executive Summary

ES.1 INTRODUCTION

This PEIS analyzes several options for carrying out fuels reduction and rangeland restoration projects on public land within portions of California, Idaho, Nevada, Oregon, Utah and Washington (see **Map 1** in **Volume 2, Appendix A**). Standalone fuels reduction projects tend to be short lived and/or require regular maintenance unless combined with restoration efforts. Therefore, to promote long term improvements in vegetation communities, fuels reduction treatments will be considered a component of restoration projects. Restoration projects would be implemented in portions of the analysis area which covers approximately 38.5 million acres of BLM-administered lands within the project area boundary. Areas excluded from analysis in this PEIS are described further in **Chapter 2**. The potential treatment areas within the analysis area vary by alternative and are defined in **Sections 2.2.3 and 2.4**. Only portions of this area would actually receive treatment. This PEIS is expected to function in tandem with the BLM's Fuel Breaks PEIS to protect intact rangelands and restoration investments.

ES.2 PURPOSE AND NEED

The purpose of this project is to enhance the long-term function, viability, resistance and resilience (see **Appendix B**, Glossary) of sagebrush communities through vegetation treatments to protect, conserve, and restore sagebrush communities in the project area. Functioning and viable sagebrush communities provide multiple-use opportunities for all user groups as well as habitat for sagebrush-dependent species.

Intact sagebrush communities are disappearing within the Great Basin due to the interactions of increased wildfires, the spread of invasive annual grasses, and the encroachment of pinyon-juniper. Restoration treatments such as fuels reduction and revegetation are needed to retain and increase intact sagebrush communities and improve their ability to resist annual grass invasion and recover from disturbance such as wildfire.

ES.3 DECISIONS TO BE MADE

The BLM's decisions will include whether, and under what circumstances, restoration projects under this PEIS would be implemented on BLM-administered lands in the Great Basin region. The alternatives evaluated in this PEIS would streamline analysis and implementation of future site-specific restoration projects, especially for cumulative effects analysis; however, site-specific actions may require further National Environmental Policy Act (NEPA) analysis. Where no additional analysis is required, BLM staff may use a determination of NEPA adequacy for site-specific projects; however, where needed, a resource issue-specific environmental assessment may be required. For example, additional analysis would be warranted if a project is in an area excluded from the analysis in this PEIS or if a project is outside the potential treatment area. Other situations requiring additional analysis are if the tools applied are other than those analyzed in this PEIS or if project design features would result in effects not disclosed in this PEIS but that could affect the natural environment. More detail on how this PEIS will be used can be found in **Section ES.8**, below.

ES.4 SCOPING AND ISSUES

During scoping, the BLM considered public comments provided during the comment period and input provided during 15 public meetings held throughout the project area. The BLM also considered internal staff input, along with input from cooperating agencies and Tribes. For more information on the scoping process, see the final scoping report on the BLM's project website, https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=186339.

During scoping, the BLM identified such issues as impacts on vegetation, direct and indirect costs and consequences of the project, and suggested components of alternatives; these issues are addressed in this PEIS. The full list of issue summaries is available in the final scoping report.

ES.5 Alternatives

Alternative A—No Action Alternative

Under the No Action Alternative, fuels reduction and rangeland restoration treatments would not be implemented using this analysis. Individual projects could be implemented when compliance with the NEPA is completed at the site-specific level. Within the project area the BLM has averaged approximately 370,000 acres (BLM 2019b) treated annually and this would likely continue under Alternative A.

Alternative B—Preferred Alternative

Under this Alternative the BLM would use a full suite of methods to restore degraded vegetation states within the 38.5-million acre potential treatment area. The range of methods available would be dependent on the vegetation state where the work is proposed. Manual, Mechanical, Chemical, Prescribed Fire, and Targeted Grazing methods could be used to remove undesirable vegetation and to establish and or encourage the expansion of desirable vegetation. The flexibility to use multiple treatment methods improves opportunities to use appropriate treatments based on a given vegetation state; however, having a variety of available treatment methods does not necessarily guarantee treatment success. Primarily native plant species would be used in restoration treatments; however, areas where successful restoration is unlikely (see **Section 2.2.9** and **Map 2**) could be improved using nonnative vegetation species to stabilize sites until adequate technology/funding for full restoration is available.

Alternative C

Under this alternative the BLM would use Manual and Mechanical methods described below to restore degraded vegetation states to the desired conditions where possible within the 26.8-million-acre potential treatment area (**Section 2.2.3** and **Map 3**). No chemical treatments, prescribed fire, targeted grazing, or nonnative plant material would be used. No sagebrush would be removed and no treatments would occur in phase III pinyon-juniper or in areas of high resistance and resilience.

Alternative D

Under this alternative, the same treatment methods and flexibility described in Alternative B, but in a more limited geographic area. The potential treatment area consists of the 5.6 million acres within the FIAT Planned Treatment Areas (**Map 4**). The FIAT did not plan treatments in Phase III Pinyon-Juniper so it is unlikely that they would occur under this alternative. The emphasis area is the same as the potential treatment area in this alternative.

Design Features

Under Alternatives B, C, and D, BLM would use design features, as applicable, when implementing site-specific projects. Additional design features may be relevant to a given project, such as from currently approved land use plans and amendments.

ES.6 IMPACT ANALYSIS

The following general impacts would be expected under Alternative B, the preferred alternative:

- Vegetation type modifications that would reduce fine and heavy fuels, create a mosaic of vegetation communities to alter fire behavior, and improve ecosystem resistance and resilience
- Increased preservation of and protection for native sagebrush habitats, soils, and cultural, Tribal and paleontological resources by decreasing the potential acres burned
- Increased habitat function, durability, and viability by restoring native vegetation communities and sagebrush habitat
- Lengthened fire return intervals over the long term
- Temporarily displaced wildlife species and disturbed habitat during treatments
- Vegetation modification and soil disturbance caused by restoration projects, which could be long term in some cases

Similar impacts would also be expected under Alternatives C and D. The effects described would vary, depending on the methods used and localized characteristics of the affected environment described in **Chapter 3**. See **Chapter 4** for a more detailed analysis of impacts by method and alternative.

ES.7 COLLABORATION AND COORDINATION

The BLM is the lead agency for this PEIS. Organizations, state, local, and Tribal governments, and other agencies invited to participate as cooperating agencies and consulting parties can be found in **Appendix L, Tables L-2** and **L-3**. The BLM's consultation and coordination efforts are described in **Chapter 5**.

The BLM sent letters to California, Idaho, Nevada, Oregon, Utah, and Washington State Historic Preservation Offices (SHPOs) in December 2017 initiating consultation, per Section 106 of the National Historic Preservation Act (NHPA). Consultation with SHPOs and Tribes will be ongoing as local projects are developed.

To comply with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), the BLM began consulting with the United States Fish and Wildlife Service (USFWS) early in the PEIS process. The USFWS provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the USFWS to identify ESA issues and to develop the biological assessment.

ES.8 HOW THIS PEIS WILL BE USED

When the PEIS is complete and a ROD is signed, the selected alternative with the associated analysis will be available for individual offices to use in developing restoration or fuels reduction projects. An interdisciplinary team would review the selected alternative and, using local data, would develop a project that adheres to the guidance of the PEIS. Then the team would evaluate whether the impacts from the project fall within those analyzed in the PEIS using a Determination of NEPA Adequacy (DNA) in accordance with BLM National Environmental Policy Handbook (H-1790-1). If the vegetative and habitat conditions and the impacts for their proposed project are in line with those analyzed in the PEIS then the office could sign a decision based on this PEIS and their DNA and implement the project. If some aspects of the proposed project are different from those analyzed in the PEIS then the office would have to do a new NEPA analysis, incorporating the pertinent analysis from the PEIS and analyzing the site-specific issues that are outside the analysis of this PEIS before issuing a decision and implementing their project. These site specific decision documents would be subject to a 30 day appeal period in accordance with 43 CFR 4.410. Coordination with Tribal, state and local governments, affected parties, and the public would still be required, but the degree of coordination and outreach would be at the discretion of the Authorized Officer. Where practicable the BLM would attempt to work with other landowners to implement projects across multiple land ownerships to improve the effectiveness of treatments.

Chapter 1. Introduction

1.1 INTRODUCTION

The BLM is preparing this PEIS in accordance with NEPA and Council on Environmental Quality (CEQ) guidance (CEQ 2014). This PEIS analyzes several options for carrying out fuels reduction and rangeland restoration projects on public land within portions of California, Idaho, Nevada, Oregon, Utah and Washington. Standalone fuels reduction projects tend to be short lived and/or require regular maintenance unless combined with restoration efforts. Therefore, fuels reduction projects will be considered a component of restoration projects. **Volume 2, Appendix A** presents maps and **Volume 3, Appendix B** presents the acronyms, literature cited, and glossary.

The project area covers approximately 223 million acres (see **Table 1-1** below and **Map 1** in **Volume 2, Appendix A**; the map in the appendix shows more detail of the project and treatment areas). Restoration projects would be implemented in an analysis area covering approximately 38.5 million acres within a subset of the project area boundary (see **Table 1-2** and **Map 1**, below). The analysis area is defined by the current and historical presence of sagebrush (*Artemisia* spp.) on BLM-administered lands. BLM further refined the analysis area by excluding areas described in **Section 2.2.1**.

Potential treatment areas would vary by alternative and are defined in **Section 2.4**. Only portions of this area would actually receive treatment.

Table 1-1
Surface Land Management in the Project Area

Surface Land Management	Total Surface Land Management Acres
BLM	90,137,000
Forest Service	46,974,000
Private	56,216,000
Bureau of Indian Affairs (Tribal)	5,748,000
US Fish and Wildlife Service	1,720,000
Other	5,723,000
State	9,071,000
National Park Service	2,304,000
Other federal	866,000
Bureau of Reclamation	819,000
Local government	175,000
Department of Defense	3,740,000
Total acres	**223,493,000**

Source: BLM GIS 2018

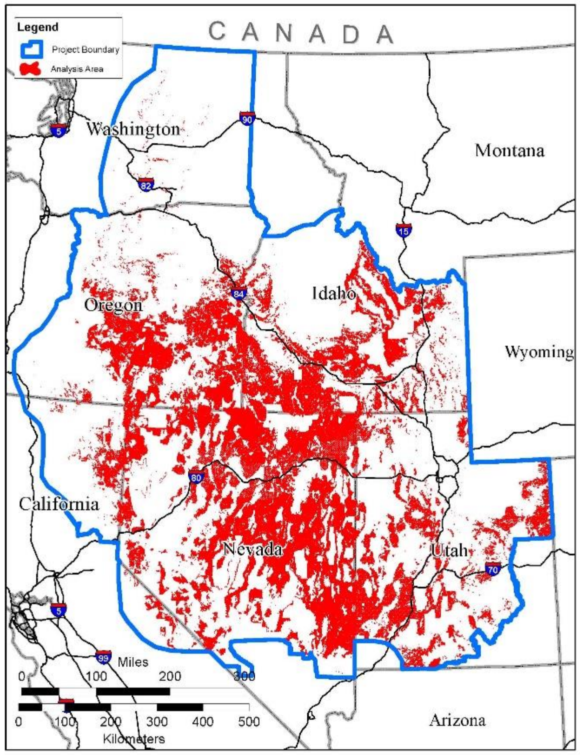
Table 1-2
Analysis Area Acres in the Project Area

State	Analysis Area Acres*
California	871,000
Idaho	7,071,000
Nevada	17,508,000
Oregon	6,795,000
Utah	5,743,000
Washington	29,000
Total acres	**38,018,000**

Source: BLM GIS 2018

* Under these alternatives, treatment acres may not be consistent with the total treatment analysis areas due to the double-counting of acres where pinyon-juniper areas overlap with other vegetation types.

Map 1
PEIS Project Boundary and Analysis Areas



The BLM is taking a regional strategic approach to protecting, conserving, and restoring sagebrush communities in the Great Basin. This PEIS is one of several expected regional PEISs that would assess a variety of vegetation treatments for improving the resistance and resilience of sagebrush communities to threats from increasing trends in wildfires and expansion of invasive plants. This strategic approach is in-line with Executive Order 13855, *Promoting Active Management of America's Forests, Rangelands, and Other Federal Lands To Improve Condition and Reduce Wildfire Risk* and Secretarial Order 3372, *Reducing Wildfire Risks on Department of the Interior Land Through Active Management*. They further aid the Greater Sage Grouse Resource Management Plan amendments (see **Appendix M** for decadal treatment objectives specified in these amendments), in which treatment areas were prioritized based on threats. It would also be consistent and support the Federal Wildland Fire Management Policy, BLM's Fire Management Planning Policy, National Fire Plan, and BLM Handbook 9211, *Fire Planning Handbook*, which among other provisions, require that firefighter and public safety be the first priority and that a full range of fire management activities be used to achieve ecosystem sustainability.

The BLM will continue cooperating and coordinating with other federal, Tribal, state, and local government agencies consistent with applicable laws and regulations pertaining to planning and implementing vegetation treatments within the analysis area. Whenever possible, this PEIS is intended to satisfy NEPA requirements for site-specific projects. As such, field staff could tier directly to this PEIS and complete an administrative determination for a restoration project, as documented in a DNA (BLM 2008a). Therefore, the analysis in this PEIS covers a range of treatments, methods, and tools and provides GIS analysis for a range of vegetation states and conditions. Additional NEPA analysis may be necessary where anticipated impacts deviate from those analyzed in this PEIS.

1.2 PURPOSE AND NEED

The purpose of the project is to enhance the long-term function, viability, resistance and resilience of sagebrush communities through vegetation treatments to protect, conserve, and restore sagebrush communities in the project area. Functioning and viable sagebrush communities provide multiple-use opportunities for all user groups as well as habitat for sagebrush-dependent species.

Intact sagebrush communities are disappearing within the Great Basin due to the interactions of increased wildfires, the spread of invasive annual grasses, and the encroachment of pinyon-juniper. Restoration treatments such as fuels reduction and revegetation are needed to increase intact sagebrush communities and improve their ability to resist annual grass invasion and recover from disturbance such as wildfire.

1.3 RELATIONSHIP OF RESISTANCE AND RESILIENCE OF SAGEBRUSH COMMUNITIES AND THE FIAT

This PEIS supports the goals and objectives of the Greater Sage-grouse Resource Management Plan Amendments (Amendments), subject to its compliance with all applicable laws, rules, regulations, and guidelines, as noted in **Section 1.4**, below. The purpose of the amendments was to adopt management strategies for addressing threats to greater sage-grouse habitat. As a part of the amendments, the BLM worked with the Forest Service, Natural Resources Conservation Service, Fish and Wildlife Service, and other stakeholders to prepare five FIAT assessments (BLM 2015), which covered portions of Nevada, California, Oregon, Idaho, and Utah. The FIAT assessments delineated various location totaling approximately 12.8 million acres for potential restoration in the Great Basin (see **Appendix N**). These areas were prioritized based on the threat of invasive species and pinyon-juniper encroachment and the potential for restoration or post-fire rehabilitation.

The FIAT assessments were based in part on the concepts of resistance and resilience. Resistance relates to a vegetation community's ability to retain its structure, processes, and function when exposed to stresses, disturbances, or invasive species. Resilience relates to a vegetation community's capacity to regain its structure, processes, and functioning after disturbance, such as wildfire (Chambers et al. 2014a, 2014b, **Appendix F, Section F.3**).

Additionally, the BLM is preparing another PEIS that addresses a system of fuel break treatments (Draft Programmatic EIS for Fuel Breaks in the Great Basin [BLM 2019a]). Collectively, this Fuels Reduction and Rangeland Restoration PEIS and the Fuel Breaks PEIS analyze components of an interconnected, region-wide strategy for addressing threats to sagebrush communities from the increasing trends in wildfire, and the spread of invasive species, including nonnative annual grasses, and pinyon-juniper. Implementing the actions proposed in these PEISs would contribute to the BLM's goal in the amendments of restoring sagebrush communities in the Great Basin.

1.4 RELATIONSHIP TO LAWS, REGULATIONS, AND BLM POLICIES, PLANS, AND PROGRAMS

This PEIS is being developed in accordance with all applicable laws, rules, regulations, and guidelines (see **Appendix C**); no federal permits, licenses, or other entitlements are needed to implement this PEIS.

The PEIS does not contradict or change any BLM policies, plans, or programs. Any subsequent site-specific NEPA compliance would also adhere to all BLM policies, plans, and programs including applicable resource management plans; BLM Manual 9211, *Fire Planning Manual*; BLM Manual 9200, *Fire Program Management*; BLM Manual 6840, *Special Status Species Management*; BLM Manuals 8110, *Identifying and Evaluating Cultural Resources* and 8140, *Protecting Cultural Resources*; and BLM Manual 1780, *Tribal Relations* (See **Appendix C**). During this project the BLM will also consider any applicable non-BLM policies, plans, and programs, as well as subsequent site-specific NEPA compliance requirements.

Chapter 2. Alternatives

2.1 INTRODUCTION

This chapter describes the alternatives for achieving treatment goals on BLM-administered lands within the project area. The alternatives respond to various issues raised and alternatives proposed during scoping, yet still meet the project's purpose and need (see **Chapter 1**). Maps are in **Appendix A**, and applicable design features for the alternatives are in **Appendix D**.

2.2 MANAGEMENT ACTIONS COMMON TO ALL ACTION ALTERNATIVES

2.2.1 Analysis Exclusion Areas

Treatments associated with this analysis are not being proposed for the following areas:

- Riparian exclusion areas
  - Perennial streams—300 feet on each side of the active channel, measured from the bank full edge of the stream or the outer extent of riparian vegetation, whichever is greater
  - Seasonally flowing streams with riparian vegetation, including intermittent and ephemeral streams and wet meadows—150 feet on each side of the active channel, measured from the bank full edge of the stream, or the outer extent of riparian vegetation, whichever is greater
  - Streams in inner gorge, defined by adjacent stream slopes greater than 70 percent gradient—Top of inner gorge
  - Special aquatic features, including lakes, ponds, wetlands, seeps, vernal pools, and springs—300 feet from the edge of the feature or the outer extent of riparian vegetation, whichever is greater
- Areas in mapped Canada lynx distribution and wolverine primary habitat
- Wilderness
- Wilderness Study Areas
- Lands with wilderness characteristics that are managed to maintain or enhance those characteristics, including natural areas managed to maintain their natural character
- National Conservation Areas and National Monuments
- Areas designated through the John D. Dingell Jr. Conservation, Management, and Recreation Act (2019)
- Visual Resource Management Class 1 areas
- Areas within a quarter-mile of a Wild and Scenic River, including rivers found eligible or suitable or both
- Within National Scenic and Historic Trails and trail ROWs/corridors as identified in the Trailwide Comprehensive Plan and applicable land use plan

2.2.2 Adherence to Existing Land Use Plans

The range of actions proposed in the alternatives may not be allowed in some areas subject to land use plan decisions in a given field office. The alternatives do not propose changing any land use plan decisions in any existing land use plans.

2.2.3 Modeling of Potential Treatment Areas

The BLM developed potential treatment areas and emphasis areas for each action alternative. Potential treatment areas represent the areas in which treatments would be allowed under that alternative. The emphasis areas represent a subset of the potential treatment areas where the BLM expects the bulk of projects to actually occur. This expectation is based on past prioritization efforts like the FIAT and designation of priority sage-grouse habitats and recovery sage-grouse habitats. Potential treatment areas were developed using the current and historic extent of sagebrush on BLM-administered land within the project area, excluding areas from treatment that were identified in **Section 2.2.1**, and removing any additional areas specific to each alternative. The potential treatment areas and emphasis areas are used for analysis and comparison purposes only; actual treatment locations would be based on site-specific conditions.

Alternative B: The potential treatment area (~38.5 million acres) consists of the current and historic extent of sagebrush on BLM-administered land within the project area with the analysis exclusion areas (**Section 2.2.1**) removed.

The emphasis area (~26.3 million acres) for Alternative B is the potential treatment area clipped to a 25km buffer around the FIAT Proposed Project Areas, the sage-grouse Recovery Habitat in Washington State, the Sage-grouse Priority Habitat Areas in Utah, and the Bi-State Critical Habitat and Coates Data in California (USFWS 2019; USFS 2015).

Alternative C: The potential treatment area (~26.8 million acres) consists of the current and historic extent of sagebrush on BLM-administered land within the project area with the following areas removed:

- Analysis exclusion areas (**Section 2.2.1**)
- Areas of high resistance and resilience (**Map 7**)
- Areas of Phase II and III Pinyon-Juniper[1] encroachment
- Shrub with Depleted Understory Vegetation State

The emphasis area (~18.7 million acres) for Alternative C is the potential treatment area clipped to a 25 kilometer buffer around the FIAT Proposed Project Areas, the sage-grouse Recovery Habitat in Washington State, the Sage-grouse Priority Habitat Areas in Utah, and the Bi-State Critical Habitat and Coates Data in California (USFWS 2019; USFS 2015).

Alternative D: The potential treatment area (~5.6 million acres) consists of the current and historic extent of sagebrush on BLM-administered land within the project area and within the FIAT Planned Treatment Areas (BLM 2015) with the analysis exclusion areas (**Section 2.2.1**) removed. The emphasis area and the potential treatment area are the same for Alternative D.

The alternative maps show potential treatment areas on BLM-administered surface land in the project area. Each alternative is independent, and descriptions of the components of each alternative are described in **Section 2.4**.

[1] Note that the phrase "pinyon-juniper" is used in this PEIS to include areas with either pinyon pine (*Pinus edulis*), juniper (*Juniperus* spp.), or both species.

2.2.4 Permitted Grazing

Any changes to permitted grazing would be in accordance with 43 Code of Federal Regulations (CFR) 4110, 43 CFR 4120, and 43 CFR 4130 (2005). However, the BLM may work with permittees through voluntary agreements or coordination within the authorized permitted use to temporarily modify grazing to increase the success of vegetation restoration projects.

2.2.5 Road Creation and Maintenance

No new roads would be created. Existing roads may be maintained within their current maintenance level but improving roads beyond the designation or maintenance level would require additional site-specific analysis.

2.2.6 Cultural, Tribal, and Paleontological

The objective of pinyon-juniper treatments is to remove encroaching pinyon-juniper in a manner consistent with Tribal treaty rights and other cultural resource laws and authorities. Project-specific consultations with federally recognized Tribes would be necessary to identify Native American traditional use areas and to consider project effects on cultural and economic values. Inventories and planning to address cultural and paleontological resources would be undertaken prior to local project implementation.

2.2.7 Native Plant Material Policy

It is the policy of the BLM to manage for biologically diverse, resilient, and productive native plant communities to sustain the health and productivity of the public lands. This policy in BLM Handbook H-1740-2, *Integrated Vegetation Management Handbook*, and the *National Seed Strategy for Rehabilitation and Restoration* (Plant Conservation Alliance 2019), requires that native plant material be used, except under limited circumstances, and provides the necessary procedures for compliance. It may be necessary to introduce nonnative plant materials to break unnatural disturbance cycles or to prevent further site degradation by invasive species. Using nonnative seeds as part of a seeding mixture are appropriate only if it is done under the following circumstances: 1. suitable native plant material is not available, 2. the natural biological diversity of the proposed management area would not be diminished, 3. exotic and naturalized species can be confined in the proposed management area, 4. analysis of ecological site inventory information indicates that a site would not support reestablishment of a species that historically was part of the natural environment, and 5. resource management objectives cannot be met with native species. For example, nonnative plant material may potentially be used in areas with low resistance and resilience that are invaded by invasive annual grasses.

2.2.8 Monitoring, Maintenance, and Adaptive Management

All vegetation management actions would be organized around phases of inventory, assessment, planning, implementation, monitoring, and evaluation and reassessment, as described in BLM Manual H-1740-2, *Integrated Vegetation Management Handbook*, and *Incorporating Assessment Inventory and Monitoring (AIM) for Monitoring Fuels Project Effectiveness Guidebook* (BLM 2018a), *Measuring and Monitoring Plant Populations* (Elzinga et al. 1998), *Sampling Vegetation Attributes* (USDA and USDOI 1999), and local RMP guidance or policy. *Using Resistance and Resilience Concepts to Reduce Impacts of Invasive Annual Grasses and Altered Fire Regimes on Sagebrush Ecosystem and Greater Sage-Grouse: A Strategic Multi-Scale Approach* (Chambers et al. 2014b) would be used as a decision support tool to determine priority areas for management and to identify effective management strategies. *Best Management Practices for Pollinators on Western Rangelands* (Xerces 2018) would be used to incorporate pollinator conservation into management decisions; the reference also describes associated monitoring practices for pollinator populations.

When conducting treatments, strategies would be determined by considering resilience to disturbance, resistance to invasive species, and the predominant threats to the sagebrush communities. The Landscape Cover of Sagebrush and Ecosystem Resilience and Resistance Matrix can be used as a decision support tool to provide better evaluation of risks and to decide where to focus specific activities to promote desired species and ecosystem conditions (Chambers et al. 2014b, Tables 2, 3, and 4). These tables provide opportunities to identify various management strategies as a response to threats to the sagebrush community and the associated tradeoffs based on resilience, resistance and resource value. When determining the appropriate vegetation management strategies, all necessary agency program areas would be consulted, such as invasive plant management, fuels management, range management, and wildlife.

Monitoring is the key to adaptive management. Monitoring would be used to gauge the effectiveness of the treatments and to identify where maintenance would be needed. When treatments are not meeting objectives, modifications should be considered through adaptive management (per Chapter 5 of H-1740-2, Crist et al. 2019). Monitoring would inform the effectiveness of treatments and the need for maintaining treatments. Maintenance may require re-treating certain areas, using the methods described in this chapter, to maintain effectiveness of treatments. A sample monitoring plan is provided in **Appendix E**.

The BLM would manage invasive annual plants and noxious weeds in accordance with local weed program monitoring protocol, along with any additional RMP guidance, through manual, mechanical, targeted grazing, prescribed fire, and chemical methods, where they are not excluded under a given alternative. This would minimize the spread of invasive annual plants and noxious weeds in the treatment areas. Noxious weed and invasive plant monitoring and management would be incorporated into all activities that disturb the soil and will include evaluation and avoidance before work begins and when retreatment is needed.

2.2.9 Vegetation States and Desired Conditions

This section describes the desired conditions associated with the treatments. Desired conditions would further be defined at the site level using goal setting and analysis following Pyke et al. (2018) or other relevant sources (**Appendix E**). Vegetation states developed for the PEIS are introduced and described in **Section 3.1.3** and are shown in **Map 5** (shrub and grassland vegetation states) and **Map 6** (pinyon-juniper states). This section also describes in further depth the desired condition as a result of restoration treatments. Supporting information on the development of the vegetation states is provided in **Appendix F**.

Projects carried out under this PEIS would move vegetation states in the project area toward the overall desired condition. This is a natural mosaic of two native perennial vegetation states: "**Perennial Grasses, Forbs, and Shrubs**" and "**Perennial Grasses and Forbs**." Both vegetation states are characterized by a diversity of native species and interspaces, with or without biological soil crust cover. As disturbance removes shrubs from one vegetation state, perennial grasses and forbs colonize vacated areas. Over time, shrub 'islands' remaining post disturbance within the sea of perennial grasses and forbs provide recruitment and opportunity for transition back to the more structurally complex vegetation state of **Perennial Grasses, Forbs, and Shrubs**.

Moving the vegetation states in the project area toward the desired condition would help maintain diverse plant communities with the capacity to better persist and stabilize ecosystem function under threats such as altered disturbance regimes and pressure from invasive species. This balanced ecosystem function is reflected in an appropriate complement of grasses, forbs, and shrubs that support a diverse plant community. Such a community can maintain its vegetation structure, function, and plant vigor over time, as indicated by plant growth, seed production, and species recruitment in the vegetation community. When these conditions exist, nutrient and hydrologic cycling lead to adequate litter and standing dead plant material for site protection, water capture, and decomposition. Minimal, if any, cover of invasive annual grasses or encroaching pinyon-juniper would be present in the vegetation states under the desired condition. These highly resilient and resistant communities have the capacity to reorganize and regain their basic characteristics when altered by stressors such as invasive plants, improper livestock grazing and altered fire regime - resilience - and retain their functional structure processes and functioning when exposed to stresses, disturbances, or invasive species - resistance.

The desired condition exhibits all necessary attributes for proper ecological function. The ecological balance of the desired condition allows for a dynamic response to threats (e.g., invasive annual grass invasion, pinyon-juniper encroachment, wildland fire). For example, when the desired condition of **Perennial Grasses, Forbs, and Shrubs** is subject to a wildfire, the likely result is a mosaic of the two desired vegetation states, **Perennial Grasses and Forbs** intermixed with areas of **Perennial Grasses, Forbs, and Shrubs**. Remaining intact shrub refugia provide a seed source for recruitment into the adjacent burned perennial grass and forb vegetation state. The shift to a perennial grass and forb vegetation state is reversible and occurs as shrubs recolonize and shift back towards a more structurally complex community with shrub.

The margins of these desired vegetation states can be transition zones between pinyon-juniper woodland and sagebrush communities. When ecological function of the plant community is balanced, there is a natural ebb and flow of pinyon-juniper encroachment within the transition zone that is mitigated by the natural fire return interval. Pinyon-juniper naturally spreads into sagebrush and perennial grass communities (Crist et al. 2019, page 89). However, wildfire is naturally more frequent in sagebrush and grassland communities and periodically removes encroaching pinyon-juniper. This ebb and flow along the margins of the sagebrush and grassland communities provides valuable habitat to a variety of species but also reduces the value of those areas for sagebrush and grassland dependent species when pinyon-juniper are not staved off. Wildfire suppression and historic grazing practices have reduced the role of wildfire in these transition areas, allowing encroachment of pinyon-juniper beyond what is expected to occur naturally.

Changes in sagebrush communities are not only correlated to ecological function of the plant community but also to environmental conditions. Elevation and moisture are strong affiliates with a plant community's resilience to stress/disturbance and resistance to invasive species (Chambers et al. 2014a). At mid- to high-elevations, higher amounts of precipitation and cooler temperatures can result in higher resource availability promoting increased plant vigor (as indicated by plant growth, seed production, and recruitment). High resistance and resilience only occurs in cool and moist areas within intact systems. In contrast, there is a shift at lower elevations to a decrease in resource availability resulting in lower plant vigor. In general, as a sagebrush community's ecological function decreases the response to disturbance and invasion moves along the resistance and resilient gradient with areas of low resistance and resilience (low elevation, warm/dry) exhibiting a greater risk to threats of invasive species and decreased recovery from disturbances. As resistance and resilience increases, this risk subsides. Low elevation, warm and dry sites could be intact or diverging from healthy function.

Low- to mid-elevation (warm/dry) sagebrush communities subjected to threats of invasion or disturbance often lack the potential to recover without significant intervention. This is evident in the many warm/dry sites in the Great Basin Region that have crossed a threshold to alternate states dominated by invasive annuals such as cheatgrass (*Bromus tectorum*). An estimated 17 million acres in the Great Basin are currently dominated by the invasive annual grass cheatgrass and it has established itself as a component of the broader plant community in an additional 62 million acres (Diamond et al. 2012 in Ielmini et al. 2015). Some areas will have crossed a threshold where it may not be technologically or financially feasible to restore them to the desired conditions. In these locations, native or nonnative plant material may be established (per BLM Handbook H-1740-2) to stabilize the location until it becomes technologically or financially feasible to fully restore to desired condition.

2.3 Methods and Tools

Methods described in Restoring Western Ranges and Wildlands (Monsen et al. 2004, pp. 57–294) and in BLM Handbook H-1740-2, Integrated Vegetation Management Handbook (BLM 2008b, pp. 64–71) are incorporated by reference; they would be used for projects under applicable action alternatives.

2.3.1 Manual and Mechanical Methods

Restoration treatments using manual or mechanical tools can be applied independently or in combination to accomplish project objectives.

Manual methods involve the use of hand tools and hand-operated power tools. Hand planting of bareroot or container stock, and hand broadcasting seed are common restoration methods.

Mechanical treatment involves the use of vehicles such as wheeled tractors, crawler-type tractors, or specially designed vehicles with attached implements designed to cut, uproot, or chop existing vegetation. The selection of a particular mechanical method is based upon characteristics of the vegetation, seedbed preparation and re-vegetation needs, topography and terrain and soil characteristics.

Monsen et al. (2004) groups mechanical equipment used for rangeland restoration into three categories. Specific tools, within each category, are further described (pp. 65-67, including Table 1).

1. Seedbed preparation equipment
2. Seeding equipment
3. Special use equipment

Preparation of a project area for seeding is accomplished by removing existing vegetation and preparing the soil for seeding. Plows or disks, chains, and harrows or drags are the common types of tools. Plows are pulled or drug behind equipment like tractors or bulldozers. Plows and disks are designed to remove plants by turning over or mixing, commonly referred to as tilling, the soil while leaving some plant residue on the soil surface.

Chains are pulled or drug behind dozers or tractors. Their primary use is to remove existing vegetation mainly shrubs and trees by either uprooting or cutting of the aboveground portion of existing vegetation by dragging the tool along the surface of the soil.

Similar in nature to chains, harrows or drags are pulled behind tractors or dozers along the surface of the soil. They prepare a seedbed through scarifying or roughing the soil surface and uprooting or removing existing vegetation.

The next step in revegetating a project area is applying seed. The typical methods to deliver seed are through drilling or broadcasting. Within the broader categories of drilling or broadcasting a variety of tools can be utilized as described in Monsen et al. (2004). Seed drills are either pulled behind or mounted to tractors and can place seed at a variety of depths in the soil. Rangeland drills are commonly used and will open a small furrow in the prepared seedbed, deposit the seed at a prescribed depth, and cover the seed by closing the furrow.

Broadcast seeding is a common method of dispersing seed on the soil surface. It can be accomplished by using ground-based equipment or aerially with fixed wing aircraft or helicopters. This type of seeding method often requires prior soil surface scarification to ensure seed is incorporated into the soil.

The land imprinter can be used as a tool for seedbed preparation and broadcasting seed. It is another tool that is pulled or dragged behind equipment (tractors and bulldozers). The imprinter is a heavy drum with metal edges that firm the soil while creating depressions into the soil surface. A broadcast seeder can be attached to the frame of the imprinter allowing for seed to be broadcast during seedbed preparation. This method will crush or compact standing vegetation as it firms the soil surface and creates micro-site depressions. It can operate on steeper rockier terrain than rangeland drills.

Transplanters can be used to plant container-grown seedlings and bareroot nursery stock. They are pulled behind or attached to a tractor. The transplanter opens a furrow in a prepared seedbed, the operator places the seedlings directly into the open furrow, and a packing wheel closes the furrow and firms the seedbed by compacting the soil around the roots of the transplanted plant material.

Manual and Mechanical Methods used for removal of Pinyon-Juniper

The use of handsaws, chainsaws or lopping with hand pruners are common methods to remove pinyon-juniper. A masticator is an implement used to shred or grind vegetation and can be attached to either tracked or tired equipment. Types of equipment can range in size from skid steers to large excavators. This type of equipment allows the operator the ability to remove specific species or individual trees within a treatment area. The operation of the equipment can crush or rip nontarget species during the removal of the target species. Shredding or grinding of pinyon-juniper produces woody slash that varies in depth, dependent on the amount of standing vegetation.

2.3.2 Chemical Treatment Methods

The BLM would use chemical treatment (herbicides) to manage undesirable species in the project area, alone or in conjunction with other treatment methods. All BLM-approved chemical treatments (herbicides), application methods, and conditions of use are incorporated by reference from the *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (EIS)* and the *Final PEIS on using Aminopyralid, Fluroxypyr, and Rimsulfuron* (BLM 2007a, pp. 4-1 to 4-11, and 2016, pp. 4-1 to 4-6), including all standard operating procedures (SOPs) contained therein. The BLM-approved chemical treatments are 2,4-D, bromacil, chlorsulfuron, clopyralid, dicamba, diuron, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, tebuthiuron, triclopyr, imazapic, diquat, diflufenzopyr (in formulation with dicamba), fluridone, aminopyralid, fluroxypyr, and rimsulfuron. Chemicals can be applied on the ground using vehicles or manual application devices, or they can be applied from the air using helicopters or fixed-wing aircraft (Monsen et al. 2004 pp. 85-87, BLM 2007a, pp. 2-13 to 2-14). The success of any method or tool is subject to a variety of uncontrollable environmental factors; given this uncertainty, it is sometimes necessary to treat an area multiple times to achieve the desired objectives.

2.3.3 Prescribed Fire

Prescribed fire could be used in conjunction with other treatments to reduce or modify existing fuel loads or prepare the ground for seeding. Qualified personnel would implement prescribed fire under specific weather and wind conditions. They would comply with direction from the Departmental Manual 620, *Wildland Fire Management*, the BLM Manual 9214, *Fuels Management and Community Assistance Manual*, and the 9214 Manual and Handbook, *Prescribed Fire Management*.

Examples of prescribed fire are broadcast, jackpot, and pile burning. Before broadcast burning begins, a fire line may be constructed via digging, using wet line, or other means around the perimeter to assist in containment. The need for a fire line, how it is constructed, and its width and length are based on site-specific conditions. The BLM would develop a prescribed fire burn plan in accordance with guidance in the PMS-484 *Interagency Prescribed Fire Planning and Implementation Procedures Guide* (NWCG 2017). For a detailed description of prescribed fire treatments and techniques, see Monsen et al. (2004, pp. 101–120).

Specialized use equipment or equipment that was not discussed above is described in Monsen et al. (2004). Targeted grazing is a method that can be used in restoration or fuels reduction treatments which is not found in the incorporated references above. That method is explained in the following paragraphs.

2.3.4 Targeted Grazing

Targeted grazing uses goats, sheep, or cattle or a combination thereof, intensively managed by a grazing operator, to consume targeted vegetation in a specific area, such as cheatgrass, medusahead rye (*Taeniatherum caput-medusae*), ventenata (*Ventenata dubia*) and nonnative perennial grasses such as crested wheatgrass (*Agropyron cristatum*). The objectives of targeted grazing for treatments are to:

- Reduce fine fuel loading
- Reduce cover and seed bank of invasive annual grasses to decrease competition against native plants; and
- Prepare a site for seeding through biomass removal

Targeted grazing used as a fuels reduction treatment would manipulate vegetation (composition, fuel continuity, or fuel loading) in areas with over 10 percent invasive annual grass or nonnative perennial grass cover and when native perennial bunchgrass cover is below 20 percent. Targeted grazing used to prepare a site for seeding would reduce cover in the treatment area through consuming and trampling of above-ground biomass. Grazing would be strategically applied across the project area. Land managers would decide, on a site-specific basis, when and where to apply targeted grazing. They would base this on a number of factors, including vegetation type, desired vegetation objectives, terrain, and current year growing conditions (see **Appendix D**). Although Smith et al. (2012) primarily addresses control of invasive annual grasses to provide a competitive advantage to perennial grasses, the chart on pages 6 and 7 in *Grazing Invasive Annual Grasses: The Green and Brown Guide* (Smith et al. 2012) is helpful in illustrating how timing of grazing is used to affect annual grasses and to minimize effects on nontarget perennial grasses. If targeted grazing is used to reduce all annual aboveground biomass in the spring, the timing of grazing may need to extend past the time when desired perennial plants initiate current year growth. Fall grazing may also be used to reduce invasive annual grass fuel loads (Foster et al. 2015).

To meet project objectives, the methods used to manage livestock, such as monitoring their numbers, fencing versus herding, and using water and mineral supplements, would be determined at the site-specific level. Their use would be at the discretion of the BLM in coordination with the grazing operator. These methods would also be documented in the targeted grazing plan (see **Appendix D**).

Temporary fencing may be used to limit grazing to the footprint of a proposed treatment area. Where temporary fencing is not used, the targeted grazing plan would identify the method used to control livestock. This would ensure that targeted grazing is confined to the treatment area.

2.3.5 Revegetation

Examples of sites that the BLM would select for a new seeding are areas where desired species have been replaced by undesirable species, such as noxious weeds or invasive annual grasses or nonnative perennial grasses. Manual, mechanical, chemical, prescribed fire, and targeted grazing methods could be used to remove undesirable vegetation and to establish and or encourage the expansion of desirable vegetation.

To replace existing vegetation, the BLM would prepare a seedbed using tools such as prescribed fire, targeted grazing, chemical treatments, tilling, or a combination of methods. After seedbed preparation, sites would either be drill seeded or broadcast seeded from the ground or air; in some areas, this would be followed by a mechanical cover treatment, such as harrowing or chaining. Such sites would be where additional seed soil contact is necessary to achieve successful establishment. In cases where retaining some or all vegetation is desired, seeding could be done by air or ground broadcasting. The use of a rangeland implement, such as a land imprinter, after seeding could ensure seed-to-soil contact. In some cases, surface broadcast seeding would require rangeland implements, such as an aerator, harrow, or chain, to ensure seed-to-soil contact.

Seedling planting, such as bare root plugs or containerized, stock plant material, could be used to enhance vegetation. When implemented in conjunction with reseeding or other methods, seedlings would be planted after desirable perennial understory vegetation becomes established. Sites selected for interplanting typically have reduced biological and structural diversity, such as areas with decreased shrub or perennial forb cover. Seedlings would be planted directly into the ground by hand or by machine (**Section 2.3.1**). Widely spacing individuals or scattering islands of species are cost-effective approaches to establishing desired species and providing a seed source from parent plants for future establishment and spread.

Treatment methods used in the pinyon-juniper group of vegetation states would use a combination of manual and mechanical tools to remove or reduce targeted species within a project site. Restoration of project sites would vary from passive in areas with intact sagebrush communities to active in areas dominated by nonnative species or areas that are predominately Pinyon-Juniper Phase II and III sites.

2.4 DESCRIPTION OF THE ALTERNATIVES

2.4.1 Alternative A—No Action Alternative

Under the No Action Alternative, fuels reduction or rangeland restoration treatments would not be implemented using this analysis. Individual fuels reduction and rangeland restoration projects could be implemented when compliance with the NEPA is completed at the site-specific level. An average of approximately 370,000 acres (BLM 2019b) are treated annually and this would continue under Alternative A.

2.4.2 Alternative B—Preferred Alternative: Protect, Conserve, and Restore Sagebrush Communities

Under this alternative the BLM would use the full range of methods described above to restore degraded vegetation states to the desired vegetation conditions, where possible, within the 38.5-million-acre potential treatment area (**Section 2.2.3**).

The emphasis area for Alternative B consists of the areas that are most likely to receive treatment based on past planning efforts like the FIAT and sage-grouse priority habitat. While projects may occur anywhere within the potential treatment area most projects are expected to occur within the emphasis area (see **Map 2**).

Primarily native plant species would be used in restoration treatments, however; areas where full restoration is unlikely (**Section 2.2.9**) could be improved using nonnative plant material to stabilize sites until adequate technology and/or funding for full restoration is available (BLM 2008b).

Manual, mechanical, chemical, prescribed fire, and targeted grazing methods could be used to remove undesirable vegetation and to establish and or encourage the expansion of desirable vegetation. The flexibility to use multiple treatment methods improves opportunities to use appropriate treatments based on a given vegetation state; however, having a variety of available treatment methods does not necessarily guarantee treatment success.

Treatments to improve degraded conditions would be allowed in all vegetation states, to move toward the desired conditions (**Section 2.2.9**). Treatments would be allowed in low, moderate, and high resistance and resilience areas. Treatments in high resistance and resilience areas would be limited to increasing native perennial grasses, forbs or shrubs. Intact communities of all resistance and resilience levels are a high priority for protection while degraded areas in moderate resistance and resilience areas would be a high priority for restoration actions. **Table 2-1** shows which treatments would be allowed in each of the vegetation states.

Table 2-1
Alternative B Treatment Options

Vegetation State	Typical Needs [1]	Treatment Options[2]
Invasive Annual Grasses	Remove invasive annual grasses and revegetate with perennial grasses (preferably native), forbs, and shrubs.	All Methods
Invasive Annual Grasses and Shrubs	Remove invasive annual grasses and revegetate with perennial grasses (preferably native), forbs, and	All Methods

Vegetation State	Typical Needs [1]	Treatment Options[2]
	shrubs.	
Perennial Grasses and Forbs (Desired Condition)	Typically none [3,4]	MAN, MEC, CH, TG[5], REV
Perennial Grasses, Forbs, and Shrubs (Desired Condition)	Typically none[4]	MAN, MECH, REV
Perennial Grasses, Forbs, and Invasive Annual Grasses	Increase perennial grass and forb component and remove invasive annual grasses	MAN, MECH, CH, TG[5], REV
Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	Increase perennial grass and forb component and remove invasive annual grasses	MAN, MECH, CH, TG[5], REV
Shrub with Depleted Understory	Remove invasive annual grasses and revegetate with (preferably native) perennial grasses, forbs, and shrubs as needed. Sagebrush may need to be thinned to allow for understory reestablishment.	All Methods
Pinyon-Juniper Phase I [6,7]	Remove juniper	MAN, MECH, PF, REV
Pinyon-Juniper Phases II and III[6,7]	Remove juniper and increase perennial grasses and forbs in the understory. Control invasive annual grasses	MAN, MECH, PF, REV

Source: BLM Interdisciplinary Team input

1. 'Needs' represents what is necessary to move degraded vegetation states towards desired condition. However, these needs may not be effectively met by the available treatment methods or current technology.
2. Treatment options: CH = chemical, MAN = manual, MECH = mechanical, PF = prescribed fire, TG = targeted grazing, REV = revegetation/seeding
3. In nonnative seedings, the nonnative perennial grasses may be removed and replaced with native perennial grasses and forbs or if invasive annual grasses are increasing and become a threat.
4. Areas where perennial grasses, forbs or shrubs are reduced, additional desirable vegetation could be planted using mechanical or manual methods.
5. Targeted grazing would be limited to areas where invasive or nonnative grasses (e.g., crested wheatgrass) are dominant or codominant in these vegetation states.
6. Pinyon-Juniper Phases include both living and dead stands
7. In sage-grouse habitat, pinyon-juniper would be removed to enhance the habitat. However, in areas unlikely to be used by sage-grouse, (e.g. steep slopes and narrow rocky ravines) stringers, groups, and clumps of trees may be left to provide habitat for mule deer. Outside sage-grouse habitat, not all Phase I would be treated and Phase II or III would be thinned while retaining adequate hiding and thermal cover.

2.4.3 Alternative C—Protect, Conserve, and Restore Sagebrush Communities through Manual and Mechanical Methods

Under this alternative, the BLM would use manual and mechanical methods described above to restore degraded vegetation states to the desired conditions where possible within the 26.8-million-acre potential treatment area (**Section 2.2.3**). No chemical treatments, prescribed fire, targeted grazing, or nonnative plant material would be used.

The emphasis area for Alternative C consists of the areas that are most likely to receive treatment based on past planning efforts like the FIAT and sage-grouse priority habitat. While projects may occur anywhere within the potential treatment area most projects are expected to occur within the emphasis area (see **Map 3**).

Only native plant species would be used in restoration treatments. No sagebrush would be removed and no treatments would occur in Pinyon-Juniper Phase III or in areas of high resistance and resilience.

Treatments to improve degraded conditions would be allowed in some vegetation states (**Table 2-2**), to move toward the desired conditions (**Section 2.2.9**). Treatments would be allowed in low and moderate resistance and resilience areas. Intact plant communities of all resistance and resilience levels are a high priority for protection while degraded areas in moderate resistance resilience areas would be a high priority for restoration actions. **Table 2-2** shows which treatments would be allowed in each of the vegetation states.

Table 2-2
Alternative C Treatment Options

Vegetation State	Typical Needs[1]	Treatment Options[2]
Invasive Annual Grasses	Remove invasive annual grasses and revegetate with perennial grasses (preferably native), forbs, and shrubs.	MAN, MECH, REV
Invasive Annual Grasses and Shrubs	Remove invasive annual grasses and revegetate with perennial grasses (preferably native), forbs, and shrubs.	MAN, MECH, REV
Perennial Grasses and Forbs	Typically none[3]	MAN, MECH, REV
Perennial Grasses, Forbs, and Shrubs	Typically none[3]	MAN, MECH, REV
Perennial Grasses, Forbs, and Invasive Annual Grasses	Increase perennial grass and forb component and remove invasive annual grasses	MAN, MECH, REV
Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	Increase perennial grass and forb component and remove invasive annual grasses	MAN, MECH, REV
Shrub with Depleted Understory	Remove invasive annual grasses and revegetate with perennial grasses (preferably native), forbs, and shrubs as needed. Sagebrush may need to be thinned to allow for understory reestablishment.	No Treatments
Pinyon-Juniper Phase I [4,5]	Remove juniper	MAN, MECH
Pinyon-Juniper Phases II and III[4,5]	Remove juniper and increase perennial grasses and forbs in the understory. Control invasive annual grasses	No Treatments

Source: BLM Interdisciplinary Team input
1. 'Needs' represent what is necessary to move degraded vegetation states towards desired condition. However, these needs may not be effectively met by the available treatment methods or current technology.
2. Treatment options: CH = chemical, MAN = manual, MECH = mechanical, PF = prescribed fire, TG = targeted grazing, REV = revegetation/seeding
3. Areas where perennial grasses, forbs or shrubs are reduced, additional desirable vegetation could be planted using mechanical or manual methods.
4. Pinyon-Juniper Phases include both living and dead stands
5. In sage-grouse habitat, pinyon-juniper would be removed to enhance the habitat. However, in areas unlikely to be used by sage-grouse, (e.g. steep slopes and narrow rocky ravines) stringers, groups, and clumps of trees may be left to provide habitat for mule deer. Outside sage-grouse habitat, not all Phase I be treated and Phase II or III would be thinned while retaining adequate hiding and thermal cover.

2.4.4 Alternative D—Reduce Threats in Planned Treatment Areas

Alternative D proposes the same treatment methods and flexibility described in Alternative B, but in a more limited geographic area. The potential treatment area is the 5.6 million acres within the FIAT Planned Treatment Areas (**Map 4**). The FIAT did not plan treatments in Pinyon-Juniper Phase III so it is unlikely that they would occur under this alternative. The emphasis area is the same as the potential treatment area in this alternative.

2.4.5 Design Features

The BLM developed design features that would be required to minimize or eliminate adverse impacts of Alternatives B, C and D on identified resources (see **Appendix D**). BLM district or field office resource specialists would determine the locations for avoidance and where to apply design features to protect resources during site-specific analyses. Additional design features may be relevant to a given project on a site-specific basis, such as design features included in land use plans. Design features will be implemented in accordance with any land use plans.

2.5 Alternatives Considered but Eliminated from Detailed Analysis

The alternatives discussed below were considered but not analyzed in detail.

Fuels reduction only. Given the increasing trend in the number and size of wildfires in the Great Basin, an alternative focused on fuels reduction treatments to achieve desired conditions was considered. This alternative was dismissed after assessing treatment objectives and determining that desired outcome for the vegetation states within the analysis area was more likely achievable through both fuels reduction and restoration treatments.

Use of wild horses and burros to reduce vegetation. During scoping, commenters suggested the use of wild horses and burros to manage vegetation, noting that, since wild horses eat cheatgrass, they could remove invasive annual grasses. This alternative was dismissed because it would not meet the purpose and need in its entirety and would be inconsistent with policy (BLM Handbook H-4700-1). Wild horses and burros may not be restored outside of existing herd management areas (HMAs) or in HMAs that are at or above appropriate management levels (AMLs); therefore, this alternative would be restricted only to HMAs below minimum AMLs. Furthermore, herding wild horses and burros would be necessary to meet the purpose and need. This would be contrary to the Wild Free-Roaming Horses and Burros Act of 1971, as amended.

Use excess wild horses and burros (through transfer of ownership) to mitigate or prevent wildfire. Transferring excess horses from government ownership to private, state, or county ownership is out of the scope of this project. Horses managed by a grazing operator could be considered for targeted grazing under the alternatives analyzed in this document; however, it is unlikely that the BLM could realistically transfer ownership of excess wild horses and burros to enough willing and capable partners to reduce fuel loading (See Section 2(b) of PL 92-195). Under such a scenario, privately managed horses or burros would need to be completely removed from the treatment area once the treatment is concluded. As a result, this alternative was eliminated from detailed analysis.

2.6 Land Use Plan Conformance

This PEIS is in conformance with applicable land use plans. Subsequent implementation-level actions would tier to this PEIS during site-specific NEPA compliance and would also document conformance with applicable land use plans at that time. Guidance in applicable land use plans supersedes the management actions presented in this PEIS.

2.7 Comparison of the Consequences of Each Alternative

Table 2-3
Comparison of the Consequences of Each Alternative

Impact Type	Alternative A No Action	Alternative B (Preferred)	Alternative C	Alternative D
Outcome	Projects would continue on a site-specific basis.	Includes 38.5 million acres within the potential treatment area (26.3 million acres within the emphasis area) in 11 different vegetation states.	Includes 26.8 million acres within the potential treatment area (18.7 million acres within the emphasis area) for potential treatment in 7 different vegetation states.	Includes 5.6 million acres within the potential treatment area in 10 different vegetation states.
Short-term impacts	No change in opportunities for projects to reduce fuel loading or shift vegetation and fire regimes toward desired conditions.	Relative to Alternative A, there would be greater opportunities for treatments to lengthen fire return intervals and create patchier burn patterns. Using chemical, manual, mechanical, prescribed fire, targeted grazing, and revegetation methods, Alternative B would remove invasive annual grasses and encroaching pinyon-juniper, while initiating the reestablishment of perennial grasses and forbs and sagebrush. This would contribute to longer fire return intervals and more mosaic burn patterns. Treatments would be prioritized in areas of low to moderate resistance and resilience to reduce continuous fuels and indirectly protect and conserve adjacent intact sagebrush communities with higher resistance and resilience. In the short term, surface disturbance and activity from	Relative to Alternative A, there would be greater opportunities for treatments to lengthen fire return intervals and create patchier burn patterns; however, compared with Alternative B, limiting the types of treatment techniques to manual and mechanical and avoiding treatments in Shrub with Depleted Understory, and Pinyon-Juniper Phases II and III would limit opportunities to restore vegetation conditions and reduce fuel loading. There would be no treatments in high resistance and resilience sites; avoiding direct effects in these areas. Requiring native seeds for reseeding treatments could limit the near-term viability of reseeding and the effectiveness of treatments in restoring desired perennial grass and forb communities. Compared with the other alternatives, this alternative would have fewer short-term adverse impacts related to disturbance from	Relative to Alternative A, there would be greater opportunities for treatments to lengthen fire return intervals and create patchier burn patterns. Alternative D would provide nearly the same opportunities for these impacts as Alternative B; however, those opportunities would be limited to an 80 percent smaller portion of the potential treatment area. The full suite of tools would be available, and all vegetation states would be considered for treatment, except for Phase III Pinyon-Juniper areas. Where treatments would occur, the short-term impacts on other resources and uses would be as described for Alternative B; however, the smaller treatment area would limit the locations where those impacts could occur; areas outside the treatment area
Short-term impacts	*(see above)*	treatments could adversely	treatments. There would be no air	would have the same potential

Impact Type	Alternative A No Action	Alternative B (Preferred)	Alternative C	Alternative D
(continued)		impact resources such as vegetation, wildlife, soils, and air. It could temporarily displace or alter recreation opportunities. Prescribed fire could also result in short term air quality impacts.	quality impacts associated with prescribed fire.	for impacts as Alternative A.
Long-term impacts	Projects would take longer to implement, which could limit opportunities to shift vegetation states and fire regimes to desired conditions. This would have further impacts on resources within the project boundary, including degradation and loss of vital Perennial Grass and Forb and sagebrush communities.	Programmatic analysis would streamline and accelerate the implementation of treatments in the project area; thus, over the long term, this alternative would increase opportunities to shift vegetation states toward desired conditions. Reducing the loss of sagebrush communities to fire, reducing invasive annual grass cover and pinyon-juniper encroachment, and improving long-term resistance and resilience would shift fire regimes to more historical conditions. This would reduce the potential for subsequent departure from desired vegetation and fire regimes.	As under Alternative B, programmatic analysis would streamline and accelerate the implementation of treatments in the project area. Compared with Alternative B, avoiding treatable locations and limiting tools would reduce opportunities for long-term desired conditions from treatments. Over the long term, there could be a continued conversion of Perennial Grass and Forb and sagebrush communities to Invasive Annual Grass or Phase I Pinyon-Juniper states. Untreated vegetation states would be susceptible to wildfire and subsequent recolonization by annual grasses. Without treatments, the fire regime in these areas would continue or deviate further from desired characteristics.	As under Alternatives B and C, programmatic analysis would streamline and accelerate the implementation of fuel break projects in the project area. In all vegetation states except Phase III Pinyon-Juniper, the potential outcomes from treatments would be the same as under Alternative B; however, Alternative D would have the smallest potential treatment area, thereby limiting areas where programmatic analysis would streamline the implementation of projects. Outside the potential treatment area, direct impacts would be the same as under Alternative A. In untreated areas in the project area, treatments in adjacent areas would indirectly reduce the potential for further departure from desired vegetation states and associated fire regimes.

Chapter 3. Affected Environment

This section evaluates the baseline condition of the environment (i.e., resources identified during internal and external scoping as requiring analysis) potentially affected by implementation of the alternatives. The evaluation describes the current condition (affected environment) of identified resource issues; consequences or effects expected from implementing each alternative are presented in **Chapter 4**. Maps are shown in **Appendix A**.

Elements of the human environment have been reviewed and the following are either not present in the project area, or would not be affected by any of the alternatives; therefore, they will not be addressed further in this document:

- Visual Resource Management Class I Areas
- Wilderness
- Wilderness Study Areas
- Wild and Scenic Rivers
- Lands with wilderness characteristics managed to maintain or enhance those characteristics, including natural areas managed to protect their wilderness character
- National Scenic and Historic Trails as identified in the Trailwide Comprehensive Plan and applicable land use plan
- Other special designations areas, such as National Conservation Areas and National Monuments
- Lands, Realty, and Cadastral Survey
- Riparian resources
- Comprehensive travel and transportation management
- Noise
- Livestock grazing[2]
- Wild horses and burros
- Water resources

Restoration treatments would lead to vegetation and the fire return interval more closely mimicking historical conditions, thereby preserving or improving these resources. In addition, without further site-specific analysis, restoration projects proposed in this PEIS would not occur in the areas listed above (in the case of wilderness and riparian areas), or would not affect or change the management of other resources (in the case of lands and realty and comprehensive travel and transportation management). Accordingly, restoration projects would have no effect on these resources, and it is unnecessary to consider them further. For a more detailed description of why these resources will not be addressed, see **Appendix G**.

[2] If permitted livestock grazing is to be affected, the permittee will be consulted and coordinated with prior to the implementation of the restoration activity. The preferred option is to plan the restoration activity to occur within the authorized permitted rotation. If that is not feasible, an agreement will be completed with the affected permittee that provides for the necessary protections for the restoration treatment (i.e., seeding).

While impacts to visual character and aesthetic qualities are discussed in **Section 3.7**, Cultural and Tribal Resources and **Section 3.9**, Recreation, and the corresponding sections in **Chapter 4**, a detailed analysis of impacts on visual resource management (VRM) categories is not included. This is because the visual resource contrast rating process associated with analyzing impacts on visual resources needs to be consistent with applicable land use plans.

3.1 VEGETATION

3.1.1 Sagebrush

Kuchler (1970) describes two potential natural vegetation types where sagebrush is dominant: the sagebrush steppe and the Great Basin sagebrush.

The sagebrush steppe vegetation type once occurred over approximately 44.8 million acres in the western US (Barbour and Billings 2000). It now occurs in the northern portion of the project area, in northern and eastern California, southern Idaho, northern Nevada, eastern Oregon, northern Utah, and eastern Washington (Kuchler 1970). Much of this area has been converted to farmland or seeded with nonnative perennial grass (e.g., crested wheatgrass) for livestock forage in the project area. Further, fire suppression, excessive livestock grazing before the passage of the Taylor Grazing Act in 1934, and invasive annual grass expansion have been responsible for permanent degradation throughout the project area (Pellant 1994, McIver et al. 2010). This is when vegetation moves from one stable state to another and cannot return to its previous state without active management (Briske et al. 2006). The following vegetation states are considered degraded areas, further described in **Section 3.1.3** below: Invasive Annual Grasses; Invasive Annual Grasses and Shrubs; Perennial Grasses, Forbs, and Invasive Annual Grasses; and Shrub with Depleted Understory (see **Table 3-2** below).

At sites in higher elevations with higher precipitation levels and soil moisture content, sagebrush steppe vegetation is more resistant to cheatgrass invasions and wildfires and more resilient to disturbances (Chambers et al. 2014b). In these areas, pinyon-juniper woodlands (see *Pinyon-Juniper Woodlands* below) naturally spread into sagebrush and perennial grass communities. When ecological function of the plant community is balanced, pinyon-juniper encroachment into sagebrush and perennial grass communities varies based on the natural fire return interval. In these transition areas, fire suppression and historic excessive grazing have provided an opportunity for encroaching pinyon-juniper to persist and increase density within sagebrush and perennial grass communities.

In contrast to the sagebrush steppe vegetation type, the Great Basin sagebrush type occurs south of the sagebrush steppe and north of the Northern Mojave Desert (creosote [*Larrea tridentata*] and blackbrush [*Coleogyne ramosissima*] deserts). The Great Basin sagebrush type is more arid and resembles deserts, whereas the sagebrush steppe type is similar to a semiarid grassland. The open density, erosive soils, and low herbaceous cover contribute to the vulnerability of this sagebrush type to plant invasions. Overall, the stability of the Great Basin sagebrush type is less than that of the sagebrush steppe type (Barbour and Billings 2000). However, similar to the sagebrush steppe, higher elevations within the Great Basin sagebrush type tend to have higher resilience to disturbance, such as wildfire, and resistance to invasive species.

Within both the sagebrush steppe and Great Basin sagebrush types (hereinafter referred to as “sagebrush communities”), there are two groups of sagebrush: tall and low. These groups are generally differentiated by the soil types on which they occur. The most common tall sagebrush groups include four major subspecies of big sagebrush (*A. tridentata*): Basin big sagebrush (*A. t.* ssp. *tridentata*), Wyoming big sagebrush (*A. t.* ssp. *wyomingensis*), mountain big sagebrush (*A. t.* ssp. *vaseyana*), and scabland big sagebrush (*A. t.* ssp. *xericensis*). Each of the subspecies occurs within a range of site conditions that include all soil textural classes.

Little sagebrush (*A. arbuscula*) and black sagebrush (*A. nova*) are two common low sagebrush species that are common in the western United States (Steinberg 2002). The low sagebrush group is particularly susceptible to fire damage. These species are usually killed by fire and do not resprout (Steinberg 2002). Site conditions are typified by relatively widely-spaced shrubs with limited herbaceous cover in the interspaces. Grass productivity is often limited by adverse growing conditions, such as eroded surfaces that expose clay-textured and calcified soils (Barbour and Billings 2000, Steinberg 2002). The low sagebrush group is relatively tolerant of wet conditions that arise due to ponding from topography and relatively low permeability of these soil types (Barbour and Billings 2000).

Under the desired condition (see **Section 2.2.9**), vegetation within the sagebrush steppe type is characterized by a natural mosaic of perennial bunchgrasses and forbs with sagebrush shrubs. The native perennial grasses associated with the sagebrush communities vary, based on elevation and other environmental factors; common species are Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needlegrasses (*Stipa* spp., *Nassella* spp.), squirreltail (*Elymus elymoides*), and Sandberg bluegrass (*Poa secunda*). Associated perennial forbs include those in the sunflower family (Asteraceae), as well as lupines (*Lupinus* spp.), paintbrushes (*Castilleja* spp.), and others. In the more arid Great Basin sagebrush type, sagebrush prevails and is accompanied by fewer grasses and forbs, even under pristine conditions (Barbour and Billings 2000).

Grasslands in the sagebrush community also include those comprised of perennial, nonnative seeded species such as crested wheatgrass (*Agropyron cristatum*), which has been widely seeded in arid and semi-arid regions of the Western US (Zlatnik 1999; NRCS 2006; McAdoo et al. 2016). Replacing native vegetation with nonnative perennial grasses, such as crested wheatgrass, was a common practice in the western US. Crested wheatgrass was first introduced in the late 1800s and 1900s. Since its introduction, it has been planted across millions of acres. It was planted to improve forage for livestock and as part of emergency stabilization and rehabilitation seeding projects. These seeded rangelands often have reduced plant diversity, especially related to forbs and shrubs (Zlatnik 1999; NRCS 2006; McAdoo et al. 2016).

More broadly, invasive plants (invasive annual grasses and others) have been introduced into the US through a variety of pathways. Invasive plants are commonly introduced in contaminated seed, feed grain, hay, straw, and mulch; movement of contaminated equipment across uncontaminated lands; animal fur and fleece; contaminated gravel, roadfill, and topsoil; and from nursery sales as ornamental plants. Invasive plants typically colonize disturbed sites such as campgrounds, trailheads, along roads and trails, unmaintained fuel breaks, landing pads, oil and gas development sites, and wildlife or livestock concentration areas; however, some species may invade relatively undisturbed areas. Once introduced, invasive plants are primarily spread by vehicles, humans, wild horses, livestock, native wildlife, and physical processes like wind and water (BLM 1998).

In many places, repeated fire in areas with shortened fire return intervals has allowed introduced species such as cheatgrass (*Bromus tectorum*) and other invasive annual grasses, including, but not limited to, medusahead (*Taeniatherum caput-medusae*) and ventenata (*Ventenata* spp.) to replace sagebrush steppe. Degraded areas with a reduced cover of perennial grasses, such as those that have been heavily grazed, are more susceptible to the invasion of annual grasses, such as cheatgrass, as well as the encroachment of pinyon-juniper woodlands.

An estimated 17 million acres in the Great Basin are currently dominated by the invasive annual grass cheatgrass. Cheatgrass has established itself as a component of the broader plant community in an additional 62 million acres (Diamond et al. 2012 in Ielmini et al. 2015).

3.1.2 Pinyon-Juniper Encroachment

Approximately 26 percent of the historically treeless sagebrush community in the project analysis area is now characterized by encroachment from pinyon-juniper woodlands (see **Table 3-3** in the Fire and Fuels section). Within the project area, the primary encroaching species are Western juniper (*Juniperus occidentalis*), in the northwest portion and Utah juniper (*J. osteosperma*) and pinyon pine (*Pinus* spp.) in the other parts (TNC 2018). Pinyon-juniper encroachment contributes to the loss of sagebrush communities. As encroachment reaches phase II and III, the additional dense canopy closure increases the risk of high-severity fires. Dense, canopy stands are more susceptible to high severity crown fires than more open sagebrush communities (Chambers et al. 2014b; Rowland et al. 2008).

As described in **Chapter 2**, pinyon-juniper woodlands naturally spread into sagebrush and perennial grass communities. As described in Miller et al. (2013), pinyon-juniper woodland expansion in the Great Basin during the 20th century has been greatest in cooler and/or moister portions of the landscape (Johnson and Miller 2006; Weisberg and others 2007). This largely coincides with soil temperature and moisture regimes that are cool to warm and moist, to cool and moist. These regimes typically include portions of black sagebrush (*A. nova*) and Wyoming big sagebrush communities occupying the cooler and moister end of their range. It also includes cool and moist mountain big sagebrush (*A. t.* ssp. *vaseyana*) and low sagebrush (*A. arbuscula*) communities with moderately deep soils (Miller et al. 2013).

The trend of increasing rates of pinyon-juniper woodland expansion into sagebrush communities is expected to continue. This is due to factors such as fire suppression, intensive livestock use, changes in climate conditions, rising temperatures, and increased atmospheric carbon dioxide (Rowland et al. 2008). Pinyon-juniper encroachment appears to be most noticeable in the more arid Great Basin sagebrush communities (Miller et al. 2008). This is because the Great Basin sagebrush type is generally less resistant to invasion, including encroachment by pinyon-juniper woodland, and less resilient from disturbances like wildfire, than the sagebrush steppe type (Chambers et al. 2014b).

In Miller et al. (2014a), the encroachment of pinyon-juniper woodlands is described as successional phases, which proceed from shrub- and herb-dominated communities to woodland-dominated communities. These successional phases are used to determine appropriate vegetation management treatments. As summarized in **Table 3-1**, below, **Pinyon-Juniper Phase I** is represented as a shrub- and herb-dominated community, where trees may be present but make up less than 10 percent of the canopy cover. In **Pinyon-Juniper Phase II**, trees and shrubs are codominant and the tree canopy ranges from 10 to 30 percent. In **Pinyon-Juniper Phase III**, the trees are the dominant vegetation and tree canopy cover is greater than 30 percent.

Table 3-1
Pinyon-Juniper Habitat Classes with Cover Breakpoints

Pinyon-Juniper Habitat Class	Percent Foliar Cover[1]	Acres (Percent of Analysis Area)

Pinyon-Juniper Habitat Class	Percent Foliar Cover[1]	Acres (Percent of Analysis Area)
Pinyon-Juniper Phase I	0–9	3,468,000 (9%)
Pinyon-Juniper Phase II	10–30	1,883,000 (5%)
Pinyon-Juniper Phase III	Over 31	1,120,000 (3%)

Source: BLM interdisciplinary team input (see **Appendix F**).
[1] the percentage of ground covered by the vertical projection of the above ground portion of plants. It is distinguished from landscape cover, which is the proportion of a given area that is covered by the vegetation type.
Note: Pinyon-juniper acres may overlap with other vegetation states.

3.1.3 Vegetation States

The analysis area has been partitioned into representative vegetation states of general plant communities that occur within the footprint of the historic and present sagebrush ecosystem. The vegetation states represent the greatly diminished flora of the sagebrush ecosystem due to expansion of flammable invasive annual grasses at lower elevations (increased fire frequency) and pinyon-juniper encroachment at higher elevations (reduced fire frequency). Each vegetation state relates to a relative amount of sagebrush, perennial grass and forb, invasive annual grass and/or pinyon-juniper foliar cover. The percent cover of each category was divided into low, medium, and high cover classes (and an intermediate class for shrubs). The conifer phases relate to the successional stages of pinyon pine and juniper forests relative to adjacent sagebrush communities where pinyon-juniper is encroaching. The methodology used to delineate "breakpoints" between each cover category and subsequent vegetation state is described in **Appendix F**, Vegetation Framework and Methodology.

Pinyon-juniper vegetation states are described in **Section 3.1.2**, Pinyon-Juniper Encroachment, and in **Table 3-1**. All other vegetation states are summarized in **Table 3-2** and described below. Brief narratives describing each vegetation state relative to its functional capabilities to reach desired condition (see **Section 2.2.9**, Vegetation States and Desired Conditions) follow the table. Vegetation states outside of desired condition have a higher risk of further degradation due to an imbalance in ecological function of the plant community. As discussed in **Section 2.2.9**, vegetation outside of the desired condition, with low resistance and resilience (typically low elevation, warm and dry sites), has a greater risk to degradation from invasive species and decreased potential to recover from disturbance. This risk subsides with vegetation exhibiting higher resistance and resilience (typically higher elevation, cooler and/or moister sites) (Chambers et al. 2014a).

In the **Invasive Annual Grasses** vegetation state, invasive annual grasses suppress native plant growth, seed production and, therefore, recruitment. Diversity and presence of native species is lacking and will continue to in the future. A lack of above- and below-ground structural diversity means that perennial and woody vegetation roots and stems are not available to trap and process nutrients and water, which leads to suppressed nutrient and hydrologic cycling and suppressed community vigor. Similarly, the **Invasive Annual Grasses and Shrubs** vegetation state has reduced function; however, a shrub component provides some structure and deeper-rooted nutrient and hydrologic cycling. Both vegetation states experience excessive fuel and fuel continuity creating a greater risk of loss from wildfire. Sagebrush communities at low elevations with dry and warm precipitation and temperature regimes are at the highest risk of converting to these vegetation states following disturbance.

Table 3-2
Description of Vegetation States within the Analysis Area

Vegetation State	Percent Cover by Vegetation Type			Description	Acres (Percent of Analysis Area)
	Percent Shrub Cover	Percent Perennial Grass and Forb Cover	Percent Invasive Annual Grass Cover		
Invasive Annual Grasses	0–5 (low)	0–5 (low)	6+ (moderate to high)	Sites dominated by invasive annual grasses	1,988,000 (5%)
Invasive Annual Grasses and Shrubs	6–25 (low to moderate)	0–5 (low)	6–26 (moderate to high)	Sites dominated by invasive annual grasses and shrubs	3,074,000 (8%)
Perennial Grasses and Forbs[1] Perennial Grasses, Forbs, and Shrubs	0–5 (low) to 6+ (intermediate to high)	6+ (moderate to high)	0–5 (low)	Desired condition; intact plant community	1,379,000 (3%) 7,281,000 (19%)
Perennial Grasses and Forbs[2]	0–5 (low)	6+ (moderate to high)	0–5 (low)	Sites dominated by nonnative perennial grasses and forbs, including nonnative seedings	2,815,000 (3%)
Perennial Grasses, Forbs, and Invasive Annual Grasses	0–5 (low)	6+ (moderate to high)	6+ (moderate to high)	Perennial grassland with invasive annual grasses occupying interspaces	3,274,000 (9%)
Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	6+ (intermediate to high)	6+ (moderate to high)	6+ (moderate to high)	Intact vegetation with invasive annual grasses occupying interspaces	8,029,000 (21%)
Shrub with Depleted Understory	15+ (moderate to high)	0–5 (low)	0–26+ (low to high)	Shrub-dominated vegetation	6,142000 (16%)

Source: BLM interdisciplinary team input (See **Appendix F)**.
Note: Pinyon-Juniper acres may overlap with other vegetation states.
[1] with a native perennial grass and forb-dominated layer
[2] with a nonnative perennial grass and forb-dominated layer

The **Perennial Grasses and Forbs** and **Perennial Grasses, Forbs, and Shrubs** vegetation states are generally intact plant communities and are the desired condition for vegetation treatments within this PEIS (see **Section 2.2.9**, Vegetation States and Desired Conditions). Both vegetation states are characterized by sufficient diversity of native species, plant vigor, and nutrient and hydrologic cycling to support the ability to suppress invasive annual grass invasion and recovery from natural disturbances. These vegetation states transition between one another following disturbance and recovery. As disturbance removes shrubs, perennial grasses and forbs increase. Over time, shrub 'islands' within this sea of perennial grasses and forbs provide recruitment, and the opportunity for a transition back to the more structurally complex vegetation state containing shrubs. Often, these areas are threatened by both invasive annual grasses and encroaching pinyon-juniper, because they are moist enough to support pinyon-juniper encroachment, and warm enough to be at risk of invasive annual grass conversion following disturbance.

Areas that have been restored or rehabilitated in the past may have more perennial grass (often nonnative) and less forbs and shrubs than would be expected in the natural vegetation state. In these cases, nonnative perennial grasses may outcompete native forbs for resources and limit forb recruitment and vigor. Recruitment of shrubs from adjacent areas may also be hindered by this competition. Above and below ground plant structure promotes plant community nutrient and hydrologic cycling; but an increase in perennial grasses and a lack of shrub recruitment can create an imbalance in the community. This makes vegetative communities more vulnerable to invasive species or pinyon-juniper encroachment. Invasive species and encroaching pinyon-juniper increase fuel loads and risk of high intensity wildfire.

The vegetation states **Perennial Grasses, Forbs, and Invasive Annual Grasses** and **Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses** are similar, relative to functional attributes, to the desired condition. However, the presence of invasive annual grasses and associated aggressive competition for resources reduces plant vigor by limiting growth, seed production and recruitment of native species. The competition for resources also disrupts the nutrient and hydrologic cycle of these vegetation states. These vegetation states, in turn, are not able to prevent further increases in invasive annual grass cover following disturbance, including drought. These vegetation states often occur in drier and warmer sites at mid and lower elevations where disturbance history has resulted in a loss of native perennial species and increased patchiness of native vegetation and bare ground. These characteristics provide an opportunity for invasive annual grasses to become established.

The **Shrub with Depleted Understory** vegetation state can result from a reduction in understory of perennial grasses and forbs. As perennial grasses and forbs are reduced, shrubs opportunistically increase which hampers resource accessibility, growth, seed production and recruitment for perennial grasses and forbs. Nutrient and hydrologic cycling is also inadequate due to the loss of structure and function from limited species diversity. Increased shrub canopy cover combined with invasive annual grass understory elevate the risk of high intensity wildfires and reduce the likelihood of natural recovery postfire.

Vegetation states containing conifers, including **Pinyon-Juniper Phase I**, **Pinyon-Juniper Phase II**, and **Pinyon-Juniper Phase III**, are described in **Section 3.2.1**, Pinyon-Juniper Encroachment, above.

3.1.4 Special Status Plants

Special status plants are those listed or proposed for listing under the Endangered Species Act (ESA) or species designated as sensitive by the BLM State Director. According to BLM policy, BLM actions must not adversely affect special status species. For this PEIS, the BLM reviewed the special status species list to determine which species have the potential to occur in the project area based on habitat association (**Appendix J**). This list includes 15 threatened, endangered, candidate, or proposed species, 5 of which have designated or proposed critical habitat. Federally listed species that may occur within the project area but would not be affected by the proposed action or alternatives were excluded from further analysis. These include species associated with open water, riverine, alpine, or subalpine habitats. **Appendix J** also lists all BLM Sensitive species with the potential to occur in the treatment area (i.e., species associated with sagebrush, pinyon-juniper, or sagebrush habitats).

Special status plant species occur in a variety of plant communities and physical habitats. The general habitat types that support special status plants in the project area are sagebrush steppe, pinyon-juniper woodlands, and grasslands, and they may be found in one or more of the vegetation states described above. Within these general habitats, they often occupy unique habitats, sediment types, or microenvironments, such as ash outcrops, playas, and sand dunes (**Appendix J**), which would be exclusion areas (see **Section 2.2.1**). Special status species are generally rare and limited in distribution, have specialized habitat requirements, and are subject to one or more threats that warrant their need for listing.

3.2 FIRE AND FUELS

Weather conditions and topography influence vegetation conditions and wildfire behavior. For example, during the summer and early fall, generally June through early October, extended periods with limited precipitation allow vegetation to cure (dry out). Human and natural ignitions such as thunderstorms, combined with wind events and cured vegetation conditions influence fire behavior, such as fire growth rates and spotting distances, with a higher probability of ignitions from spotting due to the continuing drying of fuels throughout the summer.

Fire has always been an integral natural process in most ecosystems in the project area; however, human factors are shortening the fire return intervals and influencing wildfire in these ecosystems, pushing them beyond their historical ranges of variability. Human factors include fire ignitions, fire suppression grazing management, and invasive annual grass expansion. Sagebrush ecosystems have among the most clearly altered fire regimes due to these factors (Shinneman et al. 2018). **Figure 8** in **Appendix A** depicts the total acres burned from wildfires between 1960 and 2017 on BLM-administered lands in the project area.

3.2.1 Vegetation States and Fire Return Intervals

Vegetation in the Great Basin has been changing over the last 150 years as a result of the factors described above. **Table 3-3** displays the current and historic percent cover of each vegetation states of the project area.

Table 3-3
Vegetation States and Current and Historic Percent Cover in the Analysis Area

Vegetation State	Current Percent Cover in the Analysis Area	Historic Percent Cover in Analysis Area
Invasive Annual Grasses	5%	0%
Invasive Annual Grasses and Shrubs	7%	0%
Perennial Grasses and Forbs (both native and nonnative[1])	3%	2%
Perennial Grasses, Forbs, and Shrubs	17%	98%
Perennial Grasses, Forbs, and Invasive Annual Grasses	8%	0%
Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	20%	0%
Shrub with Depleted Understory	15%	0% Unknown[2]
Pinyon-Juniper encroachment Phase I Phase II Phase III	26%	0% Unknown[3]

Source: Landfire 2019

[1]Historically, there were no nonnative perennial grasses and forbs in the project area.
[2]This vegetation state would have made up a minor component of the historic condition within Perennial Grasses, Forbs, and Shrubs.
[3] Historically the relationship between pinyon and juniper and sagebrush communities were dynamic making estimates of historic extent challenging.
Note: Pinyon-juniper acres may overlap with other vegetation states.

Map 9 displays the historic sagebrush communities that may have been dominant on the landscape in the project area. As **Table 3-2** demonstrates, much of the historic sagebrush communities have been converted to or contain uncharacteristic vegetation conditions. **Maps 10, 11,** and **12** show uncharacteristic vegetation (e.g., invasive annual grasses and pinyon-juniper) within big sagebrush, steppe and grassland, and low sagebrush communities, respectively, compared to historic conditions. Nonnative plant species now dominate many plant communities in this vegetation type (Brown and Smith 2000 and Zouhar et al. 2008). Invasive annual grasses represent a large portion of these conversions. Pinyon-juniper seedlings have also been able to establish within sagebrush communities mainly because of fire suppression or removal of fine fuels by grazing.

Fire operates differently in the various vegetation states described above. More continuous fuels increase rate of spread, which leads to larger more intense and severe fires and less mosaic burn patterns. More continuous burned areas are in turn more susceptible to convert to invasive annual grasses, which then experience shortened fire return intervals. Fire return intervals have historically been variable within the sagebrush communities and depended on ignition sources and plant community development; however, fire return intervals historically ranged between 10 to 250 years in sagebrush dominated ecosystems. **Map 13** depicts the historical fire return intervals in the project area.

Pinyon-juniper encroachment varies in density and can lead to vegetation conditions that burn more intensely than the sagebrush communities. Encroachments also alter fire behavior because they replace historic vegetation mosaics with dense, closed-canopy stands that experience increased fuel loading. These conditions can result in high-severity crown fires. **Map 6** shows encroachment phases from adjacent pinyon-juniper woodlands into sagebrush communities.

3.2.2 Fire Regime Groups

Fire regime groups characterize the presumed historical fire return intervals across the landscape, pre-settlement, based on interactions between vegetation dynamics, fire spread, fire effects, and spatial context. Natural fire regimes are determined based on the frequency of fire, combined with the severity of fire on the dominant overstory vegetation. **Table 3-4** describes the fire regime group types, and **Map 14** (**Appendix A**) depicts the fire regime groups in the project area. The fire regime groups in the analysis area per Landfire (2019) are described below. **Appendix H** contains additional information about the different ecological systems within the main vegetation types.

Steppe and Grasslands Fire Regimes I, II, and IV

Fire Regime I

Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by drought-resistant perennial bunch grasses. This regime is maintained by frequent fires when adjacent shrublands burn; most species are fire-adapted, and thus respond favorably to fire. Fires are typically mixed severity, with an average fire return interval of 37 years, and stand replacement, with an average fire return interval of 75 years.

Many of these sites have been impacted by introduced grazing and have been converted to systems dominated by shrubs or invasive annual grasses, which has shortened the fire return interval.

Table 3-4
Fire Regime Group Descriptions and Acres

Fire Regime Group	Description	Acres within Analysis Area	Percent of Analysis Area
I	0–35 year frequency,[1] low severity[2]	498,000	1.0%
II	0–35 year frequency, stand replacement severity	6,000	<0.1%
III	35–100+ year frequency, mixed severity	25,901,000	51.3%
IV	35–100+ year frequency, stand replacement severity	21,241,000	42.1%
V	200+ year frequency, stand replacement severity	2,475,000	4.9%
Barren	N/A	176,000	0.3%
Sparsely Vegetated	N/A	156,000	0.3%
Water	N/A	33,000	0.1%

Source: Schmidt et al. 2002; BLM GIS 2018
Note: Acres are rounded to the nearest 1,000. See **Map 14** for a visual depiction of fire regimes in the project area.
[1]Fire frequency is the average number of years between fires.
[2]Severity is the effect of the fire on the dominant overstory vegetation.

Fire Regime II

This regime is typically dominated by one or more perennial bunchgrasses and may contain a strong forb component. Most species in this type are fire-adapted and respond favorably to fire. The fire return intervals influenced by surrounding vegetation, fire regime, and fuel conditions, and weather are important drivers. Stand replacement fire is estimated to have an average fire return interval of 45 years, and mixed-severity has an average fire return interval of 115 years.

Many of these sites have been converted to or impacted by nonnative species, which include cheatgrass, spotted knapweed (*Centaurea maculosa*), yellow star thistle (*C. solstitialis*), and leafy spurge (*Euphorbia esula*).

Fire Regime IV

This regime occurs in sagebrush-steppe habitats where fire has removed sagebrush and local seed sources. It is typically characterized by sparse to moderately dense herbaceous layer dominated by medium-tall and short bunch grasses that are very drought-resistant. These grasslands are in a mosaic within the shrub steppe vegetation community. Fire is the primary disturbance factor and this system is maintained by frequent fires which burned when adjacent shrublands burned. The historic frequency was 30-100 years, and the historic disturbance is generally small (<10 acres), but can be as large as 10,000 acres, depending on conditions, time since last ignition, and fuel loading.

Historic heavy grazing has led to an increase of shrubs into the community. Cheatgrass and other introduced grasses have also invaded these habitats after fire, turning much of this ecosystem into annual grasslands.

Big Sagebrush Fire Regimes III and IV

Fire Regime III

Wyoming big sagebrush (*Artemisia tridentata*) dominates this regime with basin big sagebrush (*A. t. tridentata*) intermixed. Perennial bunchgrasses and forbs can be found in the understory. Fire contributed to the disturbance history of these sites, even though the dry nature and inherently low productivity of these communities limit fire occurrence. Fire frequency varies between 10 and 100 years, and the historical average fire return interval varies between 30 and 60 years. Fire size relates to existing fuel loading and burning conditions: some would burn less than 100 acres; however, wind-driven fires could burn over 10,000 acres, when fuel conditions allow. Fires generally burned in patchy mosaics and were stand-replacing, but some mixed-severity and small fires also occur. Smaller-sized fires served to break up the general canopy of denser sagebrush stands, preserving the overall average open canopy closure. The mosaic burn pattern created several age classes across the landscape that shifted from place to place based on topographical features and vegetation types.

Much of this regime has been lost due to land clearing for agriculture, frequent fire, or domestic grazing. Invasive annual grasses and encroaching pinyon-juniper have taken over the landscape in varying degrees and fueled larger and more frequent fires that contribute further to ecosystem conversion.

Fire Regime IV

This sagebrush steppe landscape is a mosaic of shrub-dominated and herbaceous-dominated phases. Wyoming big sagebrush is dominant and basin big sagebrush grows in association. The herbaceous layer is well represented, percent cover and species richness are determined by site limitations. Bare ground may be common in arid or disturbed areas, and pinyon and juniper may also be present.

Fire ignition and spread in this regime is generally considered mixed-severity and is largely a function of herbaceous cover. Historically, the average fire return interval was between 50 and 100 years. While the average patch size is 250-500 acres, fire size likely ranged from less than 10 acres to over 10,000 acres, depending on conditions, time since last ignition, and fuel loading.

Cheatgrass invasions have transformed this ecological system into large areas of uncharacteristic invasive annual grasslands, resulting in a shortened fire return interval. Cheatgrass now dominates the herbaceous layer of many big sagebrush communities. Pinyon-juniper encroachment is occurring into the big sagebrush systems. Where pinyon or juniper has encroached after 100 years without fire, the fire return interval lengthens to 125 years.

Low Sagebrush Fire Regimes III, and V

Fire Regime III

Low sagebrush species (*A. arbuscula*, *A. bigelovii*, and *A. nova*) dominate native plant communities. Pinyon or juniper may be present. Generally, these areas have relatively low fuel loads with low-growing and cushion forbs and scattered bunch grasses; therefore, fire does not carry well in this regime. Bare ground also limits fire spread in this regime, but fire spread may be possible if the season has been wet and fire starts in windy conditions. Mixed severity fires are common, with an average fire return interval of 75-140 years; however, stand-replacing fires with an average fire return interval of 200-250 years can occur when successive years of above average precipitation increases the herbaceous layer and high winds are present. Burn patch size for this type is estimated to be 10 -100 acres due to the limited potential for fire spread. Where these sites exist in a more herbaceous state, fire expands readily where there is continuity of fine fuels and wind to carry the fire.

Some stands have seen reductions in large perennial bunchgrasses and forbs from past grazing history.

Fire Regime V

This regime consists of open dwarf-shrub canopy and generally have low fuel loads with low growing forbs and scattered bunchgrasses. Bare ground acts as a micro-barrier to fire between low-statured shrubs; therefore, fire burns infrequently, fire sizes are small (less than 100 acres), and fire plays only a minor role in this fire regime as there is rarely enough continuous fuel to carry a fire. Fires burning through adjacent vegetation types may burn into the edges, but generally cannot carry through. In very unusual wet years, enough grasses may be present to allow fire to spread, especially in areas with more continuous fuels. These fires are usually stand-replacing, with a mean fire return interval of 250-500 years.

3.3 Air Resources

Air resources include climate, air quality, the atmospheric components of changing climate conditions, and certain components of noise resources—however, noise resources have been excluded from this analysis, explained in **Appendix G**. In the BLM air resources management program, visibility and smoke management are considered a component of air quality (see **Appendix C** for a description of the Clean Air Act, Regional Haze Rule and EPA's Interim Air Quality Policy on Wildland and Prescribed Fires).

3.3.1 Weather Patterns

The Great Basin region is characterized by a semiarid temperate climate with cold, wet winters, wet springs and warm, dry summers. Precipitation is spatially and temporally highly variable, with the variation usually decreasing as precipitation increases (MacMahon 1980; Miller et al. 2013). Typical wind conditions associated with the breakdown of the upper ridge/cold front passage pattern are sustained winds of 15 to 30 miles per hour, with gusts of 30 to 50 miles per hour. These are general conditions; local variations and exceptions should be expected. The breakdown can take days or hours and depends on the intensity of the surface cold front and associated upper level trough.

3.3.2 Air Quality

The EPA has set national standards for six classes of criteria air pollutants considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and particulate matter (EPA 2018a).

Particulate matter is one of the primary pollutants resulting from the combustion of fuels during wildland fires and prescribed fires. Its many components include acids (such as nitrates and sulfates), organic chemicals, metals, smoke, soil or dust particles, and allergens, such as fragments of pollen or mold spores (NWCG 2018a). Studies indicate that about 90 percent of smoke particles emitted during wildland fires are less than 10 microns in diameter (PM_{10}) and about 90 percent of the PM_{10} is less than 2.5 microns in diameter ($PM_{2.5}$) (NWCG 2018b).

$PM_{2.5}$ is the most significant of the regulated pollutants in relation to fire and the pollutant of most concern for fire managers (NWCG 2018b). $PM_{2.5}$ poses the greatest risk to human health because the small size of the particles can cause respiratory and heart problems, particularly in sensitive populations (EPA 2018b). $PM_{2.5}$ is directly emitted into the atmosphere from combustion sources, such as wildland fires, and is also produced in a secondary aerosol form when complex interactions of gases in the atmosphere form tiny particles. The larger particles in PM_{10} are of less concern to human health, but they can be a localized source of reduced visibility in the form of windblown dust.

Wildfires are a significant contributor of particulate pollutants, especially from June through October, when smoke from wildfires is most abundant. Based on the EPA's 2014 National Emissions Inventory (EPA 2018c), agricultural burning, wildfires, and prescribed fires together made up 33 percent of national $PM_{2.5}$ emissions and 12 percent of national PM_{10} emissions in 2014. A recent study (McClure and Jaffe 2018) evaluated trends in $PM_{2.5}$ from 1988 to 2016 at rural monitoring stations throughout the US. The study found that while $PM_{2.5}$ concentrations decreased in most of the contiguous US over that time period, $PM_{2.5}$ increased in the northwestern states; the increase was due to wildfire.

Most of the project area is in attainment with the national ambient air quality standards. Areas that are considered maintenance areas or nonattainment for PM_{10} and $PM_{2.5}$ are shown in **Map 15**. Prescribed fires in or near nonattainment and maintenance areas may be subject to general conformity rules (NWCG 2018b). Smoke management agencies coordinate and, if necessary, limit prescribed fires in an airshed to minimize smoke-related impacts on human health and visibility.

3.3.3 Class I Areas and Visibility Protection

Class I areas in and near the project area are shown in **Map 15**. Pollutants contributing to visibility impairment are sulfates, nitrates, organic carbon, elemental carbon, and crustal material (soil). Fires, including wildland and prescribed fires, contribute to the formation of sulfates and nitrates and are a primary source of organic carbon and elemental carbon (Malm 2001). In the western United States, 25 to 40 percent of visibility impairment is attributable to organic carbon, and 5 to 15 percent of visibility impairment is attributable to elemental carbon (EPA 2003).

3.4 CLIMATE

The plants and animals in the Great Basin are adapted to the historic climate of the area; as the climate shifts, these species also need to shift either their location or behavior to survive. Current climate predictions suggest that the Great Basin will become warmer with slightly more precipitation (IPCC 2014). The impact of shifting climate and how sagebrush communities can sequester carbon will be an important function within the Great Basin. Intact sagebrush with perennial grasses and forbs sequester and hold more carbon than invasive annual grasses. Carbon storage by shrubs is primarily in deeper soil layers underground (Meyer 2012; Bradley et al. 2006). Additionally, potential climatic shifts may enhance invasion of cheatgrass into resistant ecosystems (Bradley et al. 2016). Protection of healthy, intact ecosystems provides the associated native plants and animals a better opportunity to persist and adapt compared with ecosystems that have already been converted to invasive annual grasses.

3.5 SOILS

Soils in the project area are diverse and vary from arid saline soils to clayey glaciated soils. Similar soil types are grouped into soil orders (Jenny 1980). Ten soil orders are represented on public lands within the project boundary. A detailed description of soils by soil order is presented in the 2007 Programmatic EIS, Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007a, pp. 3-7 to 3-9). According to BLM (2007), a majority of the project area is composed of aridisols, which have extreme water deficiency, low organic matter, and poor water infiltration. Such soils are populated by desert shrubs and bunchgrass BLM (2007).

More detailed mapping of soils and associated information can be found in individual soil surveys completed for the western US; these are available at http://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/U34T.

3.5.1 Biological Soil Crusts

Biological soil crusts are commonly found on open spaces in semiarid and arid environments in the project area; however, data on the number of acres of biological soil crusts present in the project area are not available. Lower precipitation levels and less herbaceous cover promote crust development, making biological soil crusts more prevalent at lower elevations compared to higher elevations. Biological soil crusts provide important functions, such as improving soil stability and reducing erosion, fixing atmospheric nitrogen and contributing nutrients to plants, and assisting with plant growth (Belnap and Gardner 1993; Evans and Ehleringer 1993; Eldridge and Greene 1994; Belnap and Gillette 1998; Harper and Belnap 2001). Importantly, biological soil crusts present in warmer and drier sagebrush ecosystems improve the resistance of such ecosystems by reducing the germination and establishment of invasive annual grasses such as cheatgrass (Chambers et al. 2014a).

3.5.2 Erodible Soils

Erodible soils are particularly prevalent in the semiarid rangelands found in the project area (BLM 2007a). Portions of the project area that have been disturbed by events such as wildfire, road development, and extensive grazing, are now more susceptible to erosion. Soils susceptible to wind erosion in states within the project area are detailed in **Table 3-5**, below, and are shown in **Map 16**. Highly erosive soils have wind erodibility group (WEG) values of 1 or 2 and are classified as high WEG soils, due to their high susceptibility to wind erosion.

Table 3-5
Soils Susceptible to Wind Erosion

State	Acres of Highly Erodible Soils in Analysis Area
California	149,000
Idaho	437,000
Nevada	1,182,000
Oregon	410,000
Utah	1,329,000
Washington	36,000

Source: BLM GIS 2018

While erosion occurs under natural conditions, more vegetated areas and areas with biological soil crusts are less susceptible to erosion due to reduced wind erosion rates and reduced nutrient loss by dust emissions (Li et al. 2007). Disturbed areas, and areas with minimal herbaceous ground cover, such as pinyon-juniper stands, typically experience higher rates of erosion (Pierson et al. 2013).

3.6 WILDLIFE

The project area sustains an abundance and diversity of wildlife and habitat, providing permanent or seasonal homes for more than 350 species of amphibians, reptiles, birds, and mammals, many of which have been affected by increasing frequency and size of wildfires.

The status and condition of vegetation types in the project area are described in the introduction to **Chapter 3** and in **Section 3.1**, Vegetation; they reflect the availability of wildlife habitat features listed above. **Map 17** shows the locations of sagebrush, grasslands, and pinyon-juniper habitats across the project area. The condition of these habitats influences the extent to which certain wildlife species use them. For example, some sagebrush obligate species avoid areas with juniper encroachment or low sagebrush cover, while areas with dense herbaceous understories would have commensurately larger wildlife species assemblages (higher diversity). Pinyon-juniper woodlands are an important source of habitat for avian species by providing nest and perching sites, forage, and cover, but habitat use may depend on the seral stage (Paulin et al. 1997). Site conditions are described by the percent cover of the shrub, invasive annual grass, perennial grass and forb, and conifer components (**Table 3-1**, **Table 3-2,** and **Table 3-3**).

3.6.1 Terrestrial Wildlife Species

Big Game

Big game are among the species that use habitat in the project area. Species include but are not limited to: elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*). Some species, such as mule deer, have broad habitat needs and depend on both sagebrush and pinyon-juniper vegetation communities; others, such as pronghorn, use mainly sagebrush, avoiding areas of dense trees (NatureServe 2018). **Map 18** shows the distribution of habitat for these four big game species, which are used as representative species for this analysis, in the project area. Winter habitat use by mule deer is influenced by snow depth as well as forest cover. Mule deer have been observed to concentrate use in areas with sufficient thermal and hiding cover, while also providing foraging opportunities in areas with relatively low forest canopy cover (<20%). A recent study documented greater predicted use in areas with forest canopy cover (Coe et al. 2018).

The high nutrient levels of sagebrush and availability of this species above snow during winter make it a good source of forage for big game species. Animal preference of sagebrush varies with subspecies, populations, and even individual plants, due to chemical variation found in the foliage. Deer and elk tend to prefer mountain big sagebrush, followed by Wyoming big sagebrush, and finally basin big sagebrush (USDA 2018). The BLM assessed the condition of habitat for big game species throughout the project area, based on sagebrush cover, pinyon-juniper threat, and invasive annual grass threat (**Tables 3-6 and 3-7**).

Small Mammals

Terrestrial mammals, such as ground squirrels, cottontails, and mice, are common throughout much of the project area. Rodents and other small mammals use structural features, such as rocks and snags, to hide from predators and to avoid extreme temperatures. Species' distributions are influenced by vegetation, cover, elevation, soil, and other factors; many small mammals use features of sagebrush, grasslands, and pinyon-juniper vegetation.

Examples of small mammal species that rely on pinyon-juniper woodlands for security and forage are mountain cottontail (*Sylvilagus nuttallii*), cliff chipmunks (*Tamisas dorsalis*), rock squirrels (*Spermophilus variegatus*), brush mice (*Peromyscus boylii*), pinyon mice (*P. truei*), rock mice (*P. difficilis*), deer mice (*P. maniculatus*), white-throated woodrats (*Neotoma albigula*), desert woodrats (*N. lepeda*) and Mexican woodrats (*N. mexicana*) (Findley et al. 1975, in Gottfried et al. 1995).

Rodents are the largest and most diverse component of the mammalian faunas on grasslands. Species range from the small harvest mouse (*Reithrodontomys* spp.) and pocket mouse (*Perognathus* spp.) to the larger porcupine (*Erethizon dorsatum*) and beaver (*Castor canadensis*). Most grassland rodents are terrestrial and fossorial (burrowing). General habitat type (e.g., riparian, tallgrass, shortgrass) has a stronger influence on species distribution than the presence or absence of particular plant species (Rickel 2005).

Table 3-6
Acres and Condition of Big Game Grassland and Shrubland Type Habitat Within the Analysis Area

Species	Grassland				Shrubland					Other[1]	Total
	Invasive Annual Grasses	Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses and Forbs	Total Grassland	Invasive Annual Grasses and Shrubs	Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses, Forbs, and Shrubs	Shrub with Depleted Understory	Total Shrubland		
All Habitat											
Bighorn Sheep	256,000	445,000	214,000	915,000	665,000	1,804,000	1,201,000	836,000	4,506,000	915,000	6,336,000
Elk	543,000	1,232,000	757,000	2,532,000	1,055,000	5,049,000	5,594,000	2,562,000	14,260,000	2,893,000	19,685,000
Prong-horn	2,360,000	3,276,000	1,418,000	7,054,000	3,414,000	7,598,000	5,854,000	5,967,000	22,833,000	3,746,000	33,633,000
Mule Deer	1,924,000	4,119,000	1,492,000	7,535,000	3,646,000	11,260,000	9,134,000	5,984,000	30,024,000	5,811,000	43,371,000
Crucial Winter Range											
Bighorn Sheep	1,000	0	1,000	2,000	1,000	0	0	2,000	3,000	11,000	16,000
Elk	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]
Prong-horn	124,000	142,000	63,000	329,000	167,000	140,000	95,000	220,000	622,000	252,000	1,203,000
Mule Deer	273,000	331,000	141,000	745,000	506,000	715,000	704,000	710,000	3,635,000	1,470,000	4,850,000

Source: BLM GIS 2018
[1]Habitat lacking data on condition
[2] ND = No data. Elk crucial winter range was not mapped in a project area wide data set.

Table 3-7
Acres and Condition of Big Game Pinyon-Juniper Habitat Within the Analysis Area

Habitat Type	No Pinyon-Juniper Encroachment	Phase I	Phase II	Phase III	Total Pinyon-Juniper Encroachment
All Habitat					
Bighorn Sheep	5,661,000	476,000	148,000	51,000	675,000
Elk	15,957,000	1,835,000	1,273,000	620,000	3,728,000
Pronghorn	30,738,000	1,966,000	740,000	189,000	2,895,000
Mule Deer	29,968,000	3,667,000	1,981,000	874,000	6,522,000
Crucial Winter Range					
Bighorn Sheep	16,000	0	0	0	0
Elk	0	0	0	0	0
Pronghorn	1,110,000	67,000	19,000	7,000	93,000
Mule Deer	3,109,000	870,000	539,000	271,000	1,680,000

No PJ encroachment = total habitat – total PJ threat
Total PJ encroachment= all phases

Sagebrush provides thermal cover, security, and food for many small mammals. Species that are associated with sagebrush vegetation communities are black-tailed jackrabbits (*Lepus californicus*), white tailed jackrabbits (*L. townsendii*), desert cottontails (*Sylvilagus audubonii*), mountain cottontails (*S. nuttallii*), deer mice (*Peromyscus* spp.), Merriam's shrew (*Sorex merriami*), and kangaroo rats (*Dipodomys* spp.) (McAdoo et al. 2003). Many of these species use sagebrush seasonally or occasionally, while others, such as the sagebrush vole, are sagebrush obligates and require sagebrush for at least part of their life cycle (McAdoo et al. 2003).

Many species of bats may be found in sagebrush, grassland, and pinyon-juniper habitats. Roost sites are widely distributed and include rock crevices, trees, caves, buildings, and bridges. Bat species that are commonly found in pinyon-juniper habitats are eight species of Myotis, big brown bats (*Eptesicus fuscus*), spotted bats (*Euderma maculatum*), western pipistrelles (*Pipistrellus hesperus*), and pallid bats (*Antrozous pallidus*) (Findley et al. 1975, in Gottfried et al. 1995). At least nine species may be found in sagebrush habitats, but many are more closely associated with caves, rock crevices, and water sources (McAdoo et al. 2003).

Raptors

Many raptor species, including a wide variety of hawks, falcons, and bald and golden eagles, inhabit the project area permanently or as migrants. Bald eagles, which have been increasing in the contiguous 48 states due to the ban of the chemical insecticide DDT, prefer to nest in tall trees close to open bodies of water with access to fish and waterfowl. They are known to use sagebrush habitats, such as deer winter range, where they often forage for deer and other mammal carcasses during the winter and to a lesser extent throughout the remainder of the year. Golden eagles are found near mountainous areas in open country and nest on cliffs or large trees throughout the project area. Raptors, including golden eagles and hawks (*Buteo* spp.), are primary predators of greater sage-grouse (Boyko et al. 2004; Dinkins et al. 2012).

Migratory Birds

Diverse bird species use a variety of habitats for breeding, nesting, foraging, and migration throughout the project area. Both sagebrush and pinyon-juniper provide food, security, and nesting sites for various bird species. Migratory bird species with the potential to occur in the project area are listed in **Appendix I**. In the project area, fragmentation and loss of sagebrush cover and invasive annual grass conversion have decreased habitat suitability for sagebrush-dependent species.

The Birds of Conservation Concern 2008 report (USFWS 2008) identifies migratory and non-migratory bird species with the highest conservation priorities (beyond those species already designated as federally threatened or endangered). The project area overlaps the Great Basin Bird Conservation Region (BCR) 9, the Northern Rockies BCR 10 (US portion only), and the Southern Rockies/Colorado Plateau BCR 16 (USFWS 2008).

Common raven (*Corvus corax*) is a migratory species that can have significant impacts on sage-grouse nesting success. Raven population abundance in sagebrush ecosystems has increased threefold during the previous four decades (Coates et al. 2016a). Howe et al. (2013) found ravens were most likely to nest near edges of adjoining big sagebrush and land cover types that were associated with direct human disturbance or fire. Ravens frequently depredate nests of species of conservation concern, such as greater sage-grouse (*Centrocercus urophasianus*), and activities that increase edge could increase raven densities and thereby decrease sage-grouse nesting success (Coates et al. 2016b).

Reptiles and Amphibians

Western rattlesnakes (*Crotalus viridis*), gopher snakes (*Pituophis catenifer*), leopard lizards (*Gambelia wislizenii*), horned lizards (*Phrynosoma hernandesi*), and other reptiles also occupy sagebrush habitat, typically using talus slopes, cliffs, and rock outcrops as nesting and feeding habitat, thermal and escape cover, and resting sites. Amphibians inhabit only areas near water sources that may be surrounded by sagebrush or other upland habitat (McAdoo et al. 2003).

Likewise, pinyon-juniper woodlands provide valuable cover and habitat for various reptiles, including the northern desert horned lizard (*Phrynosoma platyrhinos platyrhinos*), Great Basin fence lizard (*Sceloporus occidentalis biseriatus*), Great Basin whiptail lizard (*Cnemidophorus tigris tigris*), and Great Basin gopher snake (*Pituophis melanoleucus deserticola*) (Llewellyn 1980).

Invertebrates

Previous studies reviewed the diversity of communities of soil-associated invertebrates from arid deserts that adjoin pinyon-juniper woodlands (Crawford 1986, 1990, in Gottfried et al. 1995). While invertebrate communities in sagebrush are not well understood they are important to an area's effectiveness as wildlife habitat. Invertebrates provide high-protein forage, especially in spring and early summer, when plant protein is not yet available (WGFD 2017). Invertebrates are the primary pollinators of forbs, thus helping to proliferate important components of the sage-grouse diet. Sage-grouse brood-rearing and chick survival are highly dependent on diverse and abundant forbs and insects necessary for early sage-grouse development. Insect diversity can be attributed to large, diverse, and relatively undisturbed areas of sagebrush habitat.

Special Status Wildlife

Special status wildlife species are those listed or proposed for listing under the ESA and those designated as sensitive by the BLM State Director. Threatened and endangered species and BLM sensitive species that occur or have the potential to occur in the project area are shown in **Appendix J**, Special Status Species in the Project Area. See Special Status Plants under **Section 3.1**, Vegetation for an explanation of how the Special Status Species list was generated.

The special status wildlife species with the potential to occur in the project area were grouped by habitat association for the analysis into the following three groups: sagebrush-dependent species, grassland-dependent species, and pinyon-juniper-dependent species. Representative species for the sagebrush-dependent species group include the greater sage-grouse (*Centrocercus urophasianus*) (including the Bi-State DPS), pygmy rabbit (*Brachylagus idahoensis*) (including the Columbia Basin DPS), and slickspot peppergrass (*Lepidium papilliferum*). The greater sage-grouse, which is an important sagebrush obligate, and whose habitat needs are similar to other sagebrush species, is discussed in further detail below.

Representative grassland-dependent species include the burrowing owl (*Athene cunicularia*) and Carson wandering skipper (*Pseudocopaeodes eunus obscurus*). Representative pinyon-juniper-dependent species include the ferruginous hawk (use Phase I pinyon-juniper) and pinyon jay (*Gymnorhinus cyanocephalus*).

Greater Sage-Grouse

Greater sage-grouse is a sagebrush-obligate species; it relies on sagebrush on a landscape level and on a microhabitat scale. Greater sage-grouse require large, intact, interconnected expanses of sagebrush shrubland (Connelly et al. 2004; Wisdom et al. 2011). As a landscape-scale species, greater sage-grouse move between habitats seasonally, and they generally require contiguous winter, breeding, nesting, and summering habitats to sustain a population (Connelly et al. 2011).

Sagebrush habitats vary considerably across the range of greater sage-grouse. The species uses tall, woody big sagebrush subspecies year-round, but shorter species may provide important winter, nesting, and brood-rearing habitat. Occasionally, they use shrub species such as rabbitbrush and bitterbrush for nesting cover (Connelly et al. 2011).

During the spring breeding season, male greater sage-grouse congregate to perform courtship displays to attract females in areas called leks. Males begin gathering near leks in late winter and stay on leks through spring. Leks are frequently located in open sites, surrounded by dense sagebrush cover, and sage-grouse use the same lek sites year after year (Connelly et al. 2011). Leks are an indication of nearby nesting habitat (Bradbury et al. 1989; Fedy et al. 2012) and early brood-rearing habitat. Over 90 percent of sage-grouse nesting habitats occur within 6.2 miles of occupied leks (Aldridge and Boyce 2017); thus this distance was used as a basis for the analysis in this PEIS. In the project area, approximately 34,556,000 acres are within a 6.2-mile buffer of occupied leks.

Populations of sage-grouse are threatened by the loss and fragmentation of sagebrush ecosystems due to the positive feedback between wildfire and invasive annual grass and pinyon-juniper encroachment. Sage-grouse typically avoid areas with pinyon-juniper trees, particularly areas with denser cover (Phase II and III), but may sometimes utilize sparsely encroached (Phase I) areas (Coates et al. 2016b).

The 2015 BLM Greater Sage-Grouse Records of Decision and Approved Resource Management Plan Amendments, as amended (BLM 2015), identified specific habitat management areas for the greater sage-grouse, as shown below in **Table 3-8, Table 3-9,** and on **Map 19** in **Appendix A**. The acres and condition of these habitat types within grassland, shrubland, and pinyon-juniper habitats on the analysis area are shown in **Tables 3-8** and **3-9**.

The bi-state distinct population segment (DPS), a genetically unique meta-population of greater sage-grouse in western Nevada and eastern California, is proposed for listing as threatened under the ESA, along with critical habitat for the species.

Table 3-8
Acres and Condition of Greater Sage-Grouse Habitat Management Areas Within Grassland and Shrubland Habitat Types of the Analysis Area

Habitat Type	Grasslands				Shrublands					Other	Total
	Invasive Annual Grasses	Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses and Forbs	Total Grassland	Invasive Annual Grasses and Shrubs	Perennial Grasses, Forbs, Shrubs, and Invasive Annual Grasses	Perennial Grasses, Forbs, and Shrubs	Shrub with Depleted Understory	Total Shrubland		
GHMA[1]	461,648	1,210,189	272,435	1,944,272	892,148	3,548,086	2,087,950	1,079,100	7,607,284	804,938	10,356,494
IHMA[2]	35,165	260,513	156,921	452,598	78,343	1,060,106	719,062	37,241	1,894,752	88,586	2,435,936
OHMA[3]	296,506	168,750	104,130	569,386	351,916	197,149	332,201	1,121,755	2,003,022	477,078	3,049,486
PHMA[4]	662,736	1,287,362	651,458	2,601,555	1,769,811	5,165,048	332,201	2,381,612	9,648,673	1,060,957	13,311,185
Bi-State[5]	4,320	1,183	12,449	17,952	11,005	2,623	4,582,917	173,574	4,770,118	162,042	4,950,112
Total	1,460,375	2,927,996	1,197,392	5,585,762	3,103,225	9,973,012	8,054,331	4,793,281	25,923,849	2,593,601	34,103,213

Source: BLM 2015; USFWS 2013

[1]General habitat management areas (GHMAs); BLM-administered greater sage-grouse habitat that is occupied seasonally or year-round and is outside of PHMAs

[2]Important habitat management areas (IHMAs); BLM-administered land in Idaho that provides a management buffer for and that connects patches of PHMAs; IHMAs encompass areas of generally moderate to high habitat value or populations but are not as important as PHMAs.

[3]Other habitat management areas (OHMAs); BLM-administered land in Nevada and northeastern California, identified as greater sage-grouse habitat that contains seasonal or connectivity habitat areas

[4]Priority habitat management areas (PHMA); BLM-administered lands identified as having the highest habitat value for maintaining sustainable greater sage-grouse populations; this is not a discrete habitat category and may overlap categories below

[5]Bi-State DPS habitat in western Nevada and eastern California

Note: Under these alternatives, vegetation type acres may not be consistent with the total treatment analysis areas due to the double-counting of acres where pinyon-juniper areas overlap with other vegetation types.

Table 3-9
Acres and Condition of Greater Sage-Grouse Habitat Types Within Pinyon-Juniper Habitat of the Analysis Area

Habitat Type	No Pinyon-Juniper Encroachment	Phase I	Phase II	Phase III	Total Pinyon-Juniper Encroachment
GHMA	8,837,499	848,161	420,326	250,508	1,518,995
IHMA	2,260,958	151,133	21,700	2,145	174,978
OHMA	2,752,701	192,171	93,630	10,985	296,785
PHMA	11,529,125	1,300,255	381,232	100,574	1,782,060
Bi-State	4,805,554	96,836	40,441	7,281	144,558
Total	30,185,836	2,588,555	957,329	371,493	3,917,377

Source: BLM 2015; USFWS 2013

3.7 Cultural and Tribal Resources

Cultural resources present in the project area are archaeological sites, historic and architectural buildings and structures, other resources with important public and scientific uses, and sites of traditional cultural or religious importance to Native American Tribes and other specific social or cultural groups. Cultural resources may have locally or nationally significant heritage and scientific values. Archaeological site significance is normally defined by criteria set forth in 36 CFR 60.4 based on eligibility to the National Register of Historic Places (NRHP). Tribal resources are usually identified through government-to-government consultation (See **Appendix C** for a list of applicable authorities relating to consultation) and may be protected according to specific laws and regulations (See **Appendix C**, including E.O. 13007 and 512 DM 3). Tribes and BLM share a common goal of ensuring responsible and sustainable management of natural resources and ecosystems, maintaining healthy populations of plant and animal species, and protecting sensitive species.

The Great Basin and the Plateau Native American cultural regions overlap the project area. Highly varied climate patterns, landforms, and distinct culture histories within the regions have resulted in diverse cultural traditions and adaptations over thousands of years. These diverse traditions are evidenced primarily by archaeological sites, oral and written histories and ongoing contemporary use by Native Americans. A general culture history of the project area can be found within the Handbook of North American Indians, Volume 11: Great Basin, with peripheral areas covered within Volumes 8: California, 12: Plateau, and 9 and 10: Southwest (Sturtevant, gen. ed., various dates).

Pre-contact archaeological sites of the Great Basin and Plateau culture regions are as varied as the project area itself. The project area includes early Native American sites that date to at least 13,000 years ago and contain evidence for hunting large and small game, fishing, and plant processing (Jenkins et al. 2004). Later site types found show a generally expanding range of subsistence strategies and technologies, including village sites with pit houses and other forms of architecture, seasonal sites, temporary camps, burials, caches, rock art, pinyon nut procurement and wild plant processing sites, and agricultural features. Specific geographic settings such as caves, valley floors, and margins of pluvial lakes (Elston 1986), have been identified as particularly likely to contain one or several of these site types, depending on the time period and setting.

Historic period activities involved mining, ranching, farming, railroad construction, and trail establishment. Historic-era archaeological sites include early exploration settlements and camps, mineral exploration and mining locales, mining camps, historic farms and ranches, railroad tracks and associated boom towns, and historic trail routes and associated towns.

The locations of cultural resources would be identified through site- and project- specific archaeological inventories and Tribal consultations. According to the BLM's National Cultural Resources Information Management System, less than 20 percent of the project area has been inventoried to current standards (BLM Instruction Memorandum IM 2018-079), so the affected environment for cultural resources can be described in general terms only, until specific restoration locations are defined and required site- and project- specific inventories and analyses are conducted.

The identification and location of Tribal resources and Tribal interests in projects would be determined on a site- and project- specific basis through government-to-government consultation.

Tribal resources may include a wide range of overlapping social, economic, traditional, and religious practices. Lands administered by the BLM within the project area continue to be used for subsistence, religious activities, and other cultural purposes with a range of overlapping regulations protecting these uses. Tribes may use these lands to access hunting and fishing rights, water rights, sacred places, and raw materials for uses such as basketry or tool manufacture. Plants were integral components of American Indian lifeways, and in most instances are still used in religious practices, economic enterprises, and "as subjects of cultural transmission for the heritage of future generations" (Halmo et al. 1993, p. 149). Gathering of plant materials remains an important activity within the project area (Couture et al. 1986, Hanes 1982). Access to pinyon nuts may be of particular concern to some Tribes (Clemmer 1985). The project area is also likely to include locations of religious and spiritual interest, including ancestral village sites, graves, prayer sites, pictographs, petroglyphs, talus/cache pits, rock cairns and alignments, and other culturally significant sites and landscapes.

The identification and location of Tribal resources and Tribal interests in projects would be determined on a site- and project-specific basis through government-to-government consultation.

3.8 PALEONTOLOGICAL RESOURCES

The project area includes paleontological resources preserved in sedimentary geologic units of Precambrian to Pleistocene age and surface exposures or localities. Some resources have experienced loss or destruction due to erosion, weathering, and other impacts at surface exposures and unlawful collections throughout the project area.

The BLM uses the Potential Fossil Yield Classification (PFYC) (BLM Instruction Memorandum IM 2016-124) system to determine which geologic units have known or predicted fossil resources, and hence whether additional inventory or mitigation should be considered before the project begins. The potential for fossils to be present or affected in areas proposed for fuels reduction or rangeland restoration is highly variable and would be assessed on a site- and project-specific basis (BLM Instruction Memorandum IM 2018-079).

3.9 RECREATION

The BLM's recreation program aims to sustain healthy land and water resources while promoting appropriate and responsible visitor use of those lands and waters (BLM 2014). The BLM focuses on providing developed recreation and tourism opportunities, also allowing visitors the freedom to pursue unstructured recreation activities.

Demand for recreational land has increased across the project area. Recreation activity in the project area has been steadily increasing, as population growth continues and outdoor recreation activities on public lands have been growing in popularity (See BLM 2018b). The types and quality of recreation experiences vary, as do visitors' expectations and desired outcomes. Qualities and conditions of different areas can result in distinctive recreation experiences.

Public lands provide visitors with a wide range of developed and dispersed recreation opportunities, including hunting, fishing, camping, hiking, cross-country skiing, boating, hang gliding, OHV driving, target shooting, rock climbing, mountain biking, birding, scenery viewing, and visiting natural and cultural heritage sites. Many recreation opportunities depend on roads and trails for access. Recreation sites can include campgrounds, boat ramps, trailheads, picnic areas, informational kiosks, and visitor centers.

Recreation site visits and dispersed area visits to each state in the project area in 2016 are represented in **Table 3-10**, below.

Table 3-10
Estimated Recreation Use of BLM-Administered Lands During Fiscal Year 2016

State	Recreation Site Visits	Dispersed Area Visits
Idaho	2,933,000	3,121,000
Nevada	3,408,000	4,228,000
California	4,942,000	4,550,000
Oregon/ Washington	4,108,000	4,626,000
Utah	3,404,000	3,897,000

Source: BLM 2017

3.10 Lands with Wilderness Characteristics

This PEIS addresses lands with wilderness characteristics that are managed to emphasize other multiple uses as a priority over protecting wilderness characteristics. Other lands with wilderness characteristics would not have the potential for significant impacts from the actions in this programmatic EIS and thus were dismissed from further analysis (see **Appendix G**). Lands with wilderness characteristics are present throughout the project area, and there is increasing regional interest for recreation opportunities across the project area, including in areas with wilderness characteristics.

3.11 Social and Economic Conditions

This section describes the data used for analysis of social and economic uses in the project area. More detailed data and a discussion of conditions and trends, including current conditions, trends, population and migration, housing, income distribution and poverty level, jobs and employment, public services, fiscal conditions, local economic activity, market and commodity values, nonmarket values, and ecosystem services, are provided in the Socioeconomic Baseline Report, which can be found on the project's website.

3.11.1 Demographic and Economic Overview

The six states included in the project area vary greatly in population. Since 2000, the population growth rate in the project area has been twice the United States average. In many areas, housing has expanded into the Wildland Urban Interface (WUI) to accommodate population growth. Approximately 17.3 percent of the project area WUI contains homes (Gude et al. 2008; Headwater Economics 2018). It is likely that the number of homes in the WUI and the amount of resources dedicated to preventing, suppressing, and fighting fires will increase.

As seen in **Table 3-11**, unemployment rates for states in the project area are within one percentage point of the national average. State level unemployment rates have remained similar to the national average for the past 10 years, with a trend towards decreasing unemployment since 2008 (Bureau of Labor Statistics 2018).

Table 3-11
Project Area Employment and Unemployment (2017)

State	Labor Force	Unemployment	Unemployment Rate
Washington	3,724,722	177,292	4.8
Idaho	833,462	26,299	3.2
Nevada	1,462,955	73,583	5.0
California	19,311,958	918,881	4.8
Utah	1,560,846	50,638	3.2
Oregon	2,104,078	86,786	4.1
United States	**160,597,000**	**6,982,000**	**4.4**

Source: Bureau of Labor Statistics 2018
Note: Annual unemployment rate for 2017; reflects revised population controls and model re-estimation.

Across the project area, the greatest percentage of each state's population is employed in service industries (US Bureau of Economic Analysis 2016). Farming, agriculture, forestry and fishing and other jobs more directly related to public land use represent a minor portion of the state employment; however, these jobs may represent a higher proportion of employment at the local level.

3.11.2 Contributions from Public Lands

Contributions from public lands in the project area include those from livestock grazing, oil and gas leasing, mineral development, recreation, ROW development, forest and woodland products, and revenue generated from payments in lieu of taxes (PILT). For FY 2016, the total revenue generated by receipts received by the BLM for ROW development, including for solar and wind projects, amounted to over $47 million (BLM 2017). Value of all receipts from all wood product sales on BLM-administered lands in the project area was $46,569,501 in FY 2016 (BLM 2017). PILT payments for all DOI lands within each state in the project area for FY 2017 totaled $184,966,879 (DOI 2018).

In 2017, BLM lands in the project area supported a total of 6,001,584 active AUMs of forage allocated to livestock grazing. In fiscal year (FY) 2016, livestock grazing bills, leases, and permit receipts for the project area was $6,154,503 (BLM 2017).

Revenue related to oil and gas leasing and mining is difficult to determine, given the decentralized nature of the industries. Based on FY 2016 data, there were a total of 176 applications for permits to drill for oil and gas and 1,879 producing leases on BLM-administered lands in project area states. In addition, in FY 2016, the BLM reviewed 267 notices and plans of mining operations. Receipts from mineral leases and permits in project area states totaled $3,781,421 (BLM 2017). Additional receipts were generated from mining claim holding fees, applications for permits to drill, and non-operating revenue.

Recreational opportunities include hunting, fishing, camping, hiking, cross-country skiing, boating, hang gliding, off-highway vehicle driving, mountain biking, birding, viewing scenery, and visiting natural and cultural heritage sites. In total fees related to recreation activities and collected from BLM-administered lands in the project area in FY 2016 were $53,519,360 (BLM 2017).

3.11.3 Wildfire

The number of wildfire incidents and the acres burned in a fire season vary based on precipitation levels, seasonal fuel loading, and other conditions. In recent years, however, the number of acres burned by fires has generally increased (NIFC 2013, 2014, 2015, 2016, and 2017).

Costs associated with wildfire suppression and other wildfire management activities have had a general increase in recent years. Wildfire management appropriations began to increase in the late 1990s and increased significantly after FY2000, beginning with the severe 2000 fire season. In FY 2001, the budget for the discretionary Department-wide Wildland Fire Management (WFM) program was enacted at $1.9 million (USFS 2002). In comparison the FY 2018 budget request for the discretionary Department-wide Wildland Fire Management (WFM) program is $873.5 million (DOI 2017b).

In recent decades, federal spending on wildfire suppression has increased dramatically. For example, suppression spending that on average accounted for less than 20 percent of the Forest Service's discretionary funds prior to 2000 had grown to 43 percent of discretionary funds by 2008 (USDA 2009), and 51 percent in 2014 (USDA 2014). Both historically and today, annual suppression expenditures increase with the total number of acres burned (Ellison et al. 2015).

During the five-year period between January 2014 and December 2018, 11 separate wildland fires exceeded 100,000 acres in size and burned a combined total of 2.2 million acres within the Great Basin (Idaho, Utah, Nevada, Oregon, California), mostly on BLM-administered federal lands. In addition to the suppression costs of $ 21.0 million for these fires, the BLM obligated $51.4 million for Emergency Stabilization and Burned-Area Rehabilitation making the total costs $72.4 million to date. This figure will likely increase, because six of those fires occurred in 2017 and 2018, and the BLM continues to support recovery efforts for those fires (BLM 2019 unpublished data).

A major contributor to suppression costs is the use of retardant. Delivering retardant to wildland fires is a reactive response that functions in a similar manner to fuel breaks in that it acts to slow a fire's progress. During the same five-year period (2014-2018), the BLM delivered over 30 million gallons of retardant at a cost of $87.4 million which does not include aircraft costs associated with delivery. For reference, an average large air tanker would use almost 16,000 gallons of retardant to cover a distance of one mile at a total cost of over $77,000. Another consideration is that a retardant drop is a one-time treatment that would not be effective during subsequent fire seasons.

Other costs associated with wildfires are related to direct property losses, though no single database tracks such costs. Between 2002 and 2006, one review estimated that an annual average of 1,248 structures were damaged in wildfires, at an estimated loss of $160.2 million. After adjusting for inflation using the consumer price index from the Bureau of Labor Statistics, the average per structure loss is $143,094 in 2016 dollars (Thomas et al. 2017). According to NIFC data, a total of 4,312 structures were destroyed by wildfires in 2016, but it does not provide a dollar estimate of the losses. Using the average per structure loss calculated above, wildfires in 2016 resulted in an estimated $617 million in property damage (Thomas et al. 2017). More homes built in the WUI are expected to increase wildfire prevention and suppression costs, as well as cost of damaged property from wildfire.

The following primary risk factors are driving the prospects of more severe fire in the future: continued accumulation of fuels in forests and rangelands; continued development in the WUI; continued drought; and a general increase in temperatures (USDA and USDOI 2015). Based on current trajectories, these factors have worsened and will continue to worsen over the next 20 years and may lead to more destructive wildfires (USDA and USDOI 2015).

3.11.4 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations, requires that federal agencies identify and address any disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations.

The Socioeconomic Baseline Report (BLM 2018b) provides more detail on the demographics of the counties in each state related to environmental justice. Data indicate that California has the most counties that meet the criteria for further consideration of environmental justice impacts, based on the percent of the population in those counties identified as low-income, minorities, or both (BLM 2018b). Due to the size of the project area, further site-specific analysis would be required to further define potential for consideration.

Chapter 4. Environmental Consequences

4.1 Introduction

This chapter discloses the direct, indirect, and cumulative impacts for each resource and provides the scientific and analytical basis for evaluation of the potential effects of each of the alternatives described in **Chapter 2**.

4.1.1 Assumptions for Analysis

The following assumptions for analyzing direct, indirect, and cumulative impacts apply to all resource sections in this chapter. Resource-specific assumptions are detailed under each resource below.

- Short-term effects would occur within 5 years of implementation; long-term effects would occur more than 5 years after implementation.
- Alternatives B, C, and D provide regional analysis and consultation that could be applied at the site-specific level.
- While acres potentially available for treatment may be presented, not all of these acres would receive treatment under any action alternative. Decadal treatment objectives from the Greater Sage-Grouse ARMPAs are presented in **Appendix M**.
- All direct effects would occur within the treatment area.
- Projects would be maintained with regular treatments in order to meet project objectives. The potential for a treatment to fail to initially achieve desired condition as described in Section 2.2.9 is an expected outcome to some degree under all action alternatives. In this case, the short-term effects of treatments as described under each resource below would continue until desired conditions are achieved.

In all vegetation states, the highest potential resistance and resilience occur with cool to cold (frigid to cryic) soil temperature regimes and relatively moist (xeric to ustic) soil moisture regimes, making these areas more resilient to disturbance, including from wildfire, and more resistant to invasion of annual grasses. Thus, they are less likely to experience subsequent departures from historic vegetation conditions following fire. The lowest potential resistance and resilience occur with warm (mesic) soil temperatures and relatively dry (aridic) soil moisture regimes, which make these areas less resistant to invasion of annual grasses and more vulnerable to departure from desired sagebrush and perennial grass and forb vegetation communities (Chambers et al. 2014, Chambers et al. 2017).

4.1.2 Cumulative Effects Assessment Approach

The evaluation of potential cumulative impacts considers how both incremental impacts and foreseeable long-term impacts of the proposed project overlap in place and time with the impacts from past, present, and reasonably foreseeable future actions and may be resource-specific. Management actions could be influenced by activities and conditions on adjacent public and non-public lands; therefore, assessment data and information could span multiple scales, landownerships, and jurisdictions. These assessments involve determinations that are often complex and, to some degree, subjective.

The cumulative impacts discussion that follows considers the alternatives in the context of the broader human environment, specifically actions that occur outside the potential treatment areas but within the larger project area boundary.

Unless otherwise specified below, the cumulative effects analysis area is the project area boundary. The timeframe used for the cumulative effects analysis is the period over which restoration projects would occur, likely several decades.

Past, Present, and Reasonably Foreseeable Future Actions

Projects and activities identified as having the greatest likelihood to generate potential cumulative impacts when added to the alternatives analyzed in this PEIS are displayed in **Table 4-1**, below. It is assumed that these past, present, and reasonably foreseeable future actions would continue under all alternatives and for all resources.

Table 4-1
Past, Present, and Reasonably Foreseeable Projects, Plans, or Actions that Comprise the Cumulative Impact Scenario for Fuels Reduction and Rangeland Restoration

Past and Present Projects, Plans, or Actions	
Human Actions	
Fire Suppression	Fire suppression was practiced throughout the western US for most of the 20th century with full suppression of any wildfire. This practice has led to an increase in fuel loading and increased risk of high-intensity wildfires in grasslands and sagebrush communities. Wildfire is now recognized as a natural ecosystem process necessary for ecosystem health, however, fire suppression is still practiced in many areas including on some public lands. Interagency Federal fire policy requires that every area with burnable vegetation must have a Fire Management Plan (FMP). Accordingly, the BLM has established FMPs in parts of the project area. Examples include the Central Utah FMP, and the California Master Cooperative Wildland FMP and Stafford Act Response Agreement. Further, entities like the National Interagency Fire Center (NIFC) coordinate five federal agencies and cooperate with state and local jurisdictions to develop and implement federal wildfire policies.
Fuel Breaks	Fuel break projects have been and continue to be implemented throughout the project area by the BLM, other federal agencies such as the Forest Service, local or regional partnerships, and other groups. While this is not a complete list of projects, examples include: Nevada/California ● Battle Mountain District Office Roadside Fuel Break Hazardous Fuels Reduction Project (30,000-acres of fuel breaks [no mileage given]) ● Granger Canyon Fuel Break Project (4.5 miles of fuel break) Idaho ● Bruneau Fuel Breaks Project (128 miles of fuel breaks) ● Paradigm Fuel Break Project (294 miles of fuel breaks) ● Soda Fuel Breaks Project (442 miles of fuel breaks) ● Big Desert Roads Fuel Breaks Project (30 miles of fuel breaks) Oregon/Washington ● Cascade Crest Fuel Breaks Project (852-acres of fuel breaks [no mileage given]) Utah ● Midway Fuel Break Project (7.5-miles of fuel breaks) ● Dry Basin Greenstrip Project (13 miles of fuel breaks) These projects have created and will continue to create fuel breaks in the project area over the next several years.

Past and Present Projects, Plans, or Actions	
Human Actions	
Vegetation Management	Vegetation management projects have occurred throughout the project area and projects such as hazardous fuels reduction, pinyon-juniper removal, emergency stabilization and rehabilitation (ESR), and invasive species control have impacted vegetative cover and structure, which in turn influence wildfire risk. These projects have been and continue to be implemented not only by the BLM but also by other federal and state land management agencies and private landowners (sometimes in coordination with federal or state agencies). Projects follow those requirements found in 43 CFR 4180. While this is not a complete list of projects, examples include: Nevada/California ● West Carson Fuels Project (500-acre project area) ● BLM California State Office Hazard Removal and Vegetation Management Project (up to 20,000-acre project area) Idaho ● Goose Creek Sage-Grouse Habitat Restoration Project (49,839-acre project area) ● Sawtooth and Boise National Forests Invasive Species Project (4,437,000-acre project area) ● Bruneau-Owyhee Sage-Grouse Habitat Project (617,000-acre project area) ● Challis and Salmon Sagebrush-Steppe Vegetation Restoration Project (164,300-acres project area) ● Trout Springs Juniper Treatment (13,734-acre project area) ● Pole Creek Juniper Treatment (6,608-acre project area) Oregon/Washington ● Alder Slope Cooperative Partnership (6,546-acre project area) ● South Warner Juniper Removal Project (69,000-acre project area) ● Otis Mountain/Moffet Table Fuels Management Project (22,547-acre project area) ● Northwest Malheur County Greater Sage-Grouse Habitat Restoration Project (258,556-acre project area) Utah ● Glendale Bench Vegetation Management Project (905-acre project area) ● Tom Patterson Prescribed Fire Hazardous Fuel Reduction (23,697-acre project area) ● Hamlin Valley Sagebrush Habitat Restoration (1,376 acres) ● Fremont-Little Valley Mastication and Reseeding (1,350 acres) ● Range Creek Phase I Maintenance (60,184-acre project area) Other aspects of vegetation management plans, including but not limited to commercial timber harvesting, lop and scatter, prescribed fire, and thinning have also occurred. The exact projects and their site-specific impacts vary throughout the project area, though treatment effects are often similar to those described for this project: improved structure, function, and diversity of plant communities in the ecosystem. Vegetation projects will continue throughout the project area and new projects will be proposed, regardless of decisions made in this PEIS. Existing conditions regarding restoration are presented in Chapter 3.
Resource Management/ Land Use Plans	Multiple land use plans dictate the management of certain areas within the project area. Goals, objectives, and strategies for managing wildfire and improving vegetation conditions are described in specific comprehensive plans and vary among them. Land use plans will continue to dictate the management of certain areas within the project area, with impacts varying based on specific plan goals and objectives. Plans will continue to be updated to reflect best management decisions for current conditions.
Human Developments	Human developments, such as mining and materials sites, energy projects (e.g., solar), utility projects (e.g., transmission lines), and commercial and residential construction, have removed native habitats, often reducing habitat value for many species. This has contributed to habitat fragmentation, changes in wildlife habitat use patterns, and increase in invasive plant introduction and spread.

Past and Present Projects, Plans, or Actions	
Human Actions	
Roads and Rights-of-Way	Effects on vegetation and wildfire potential from roads and ROWs (including pipelines, electrical transmission lines, infrastructure ROWs, and large renewable energy projects, such as wind development projects) have occurred throughout the project area. In addition, the BLM has designated the west-wide energy corridors, which run throughout the project area. Increasing development and population growth have increased demand and construction of transportation routes within the project area. Use of roads in the project area is a common cause of wildfires because of the increased potential for roadside ignition; road use is also a source of spread for invasive annual grasses. This trend is expected to continue.
Livestock Grazing	Excessive historic grazing pressure has modified sagebrush communities over many areas in the western US. Domestic livestock modified much of the native grass in the Great Basin by the early twentieth century, and more recently, less than 1 percent of the sagebrush communities in the region remains untouched by livestock (Paige and Ritter 1999). To ensure that BLM administration of grazing helps preserve currently healthy conditions and restores healthy conditions of rangelands, the BLM has approved Grazing Management (43 CFR 4120) and Authorized Grazing Use (43 CFR 4130) to guide grazing management.
Agriculture	According to LANDFIRE, approximately 14.6 million acres within the project area (6.5 percent) are categorized as "agriculture." Agricultural practices have historically converted native habitats to cultivation or dairy/cattle operations, often reducing habitat value for many species. Agriculture has contributed to habitat fragmentation, changes in wildlife habitat use patterns, and dust.
Mining and Fluid Mineral Development	Mining and fluid mineral leasing, exploration, and development have been and continue to occur in the project area. Impacts associated with mining and fluid mineral exploration and development relate to surface and subsurface disturbance from exploration and development actions and infrastructure developed to support mining and fluid mineral exploration and development activities. Examples of past and present mineral development activities within the project area include the following: ● May Day Mill/Crescent Creek Mine ● Tucker Hill Perlite Mine Expansion ● Uinta Basin Natural Gas Development Project ● Smoky Canyon Phosphate Mine ● Blackfoot Bridge Phosphate Mine
Recreation	Visitors to the project area participate in a variety of dispersed, concentrated, and organized recreation activities. Dispersed activities, such as hunting or backpacking, occur throughout the project area with typically localized, short-term changes to resource conditions. Organized and concentrated activities generally take place near roads, trails, water bodies, and developed recreation areas with more intense resource impacts compared with dispersed recreation, but over a smaller area. Overall visitor use is generally higher in the summer months, but specific activities, such as hunting or cross-country skiing, have more participants and associated impacts outside the summer season.

Past and Present Projects, Plans, or Actions	
Natural Processes	
Spread of Noxious and Invasive Weeds	Noxious weeds have invaded many locations in the project area, carried by wind, humans, machinery, and animals. Integrated weed management programs, including biological, chemical, mechanical, manual, and educational methods, act to minimize noxious weed spread. Examples include the Burns District Noxious Weed Management Program, the Twin Falls District Noxious Weed and Invasive Plant Treatment Program, and the Spokane District Programmatic Vegetation Restoration Project. State and regional entities like the California Invasive Plant Council, the Pacific Northwest Invasive Plant Council, and Northern Rockies Invasive Plant Council rely on management tools like the establishment of weed management districts; invasive plant mapping and prioritization schemes; and prevention, early detection and rapid response measures to manage vegetation in their respective areas. These Invasive Plant Councils also develop and support public policy initiatives at the state and national levels to help control the spread of invasive plants.
Wildland Fire and Fuels	Fires in the project area are both natural and human caused. The approximate number and size of wildfires in the project area are presented in Chapter 1. Wildfires have been widely distributed in terms of return interval and severity. Factors contributing to the lengthening of fire return intervals, and severity include increased fuel loading and continuity in high risk fire areas, and drier conditions caused by drought. Increasing recurrence and severity of drought conditions could increase the occurrence and severity of wildfires in the project area.

Reasonably Foreseeable Future Projects, Plans, or Actions	
Human Actions	
Fire Suppression	Fire suppression throughout the project area will continue. The NIFC will continue to coordinate federal agencies and cooperate with state and local jurisdictions to develop and implement wildfire policy with a focus on protection within the WUI. Further, BLM will continue to implement and update mandated project area FMPs in light of new technology and changing environmental conditions. State and local agencies are likewise expected to continue developing, updating, and implementing fire management policies in response to changing technology and environmental conditions.
Fuel Break Projects	Future fuel break projects in the project area include: those fuel break projects identified in the present actions, amendments to such projects based on changing technology and environmental conditions, and a regional system of fuel breaks in the same 6-state area within the Great Basin that is under development by the BLM known as the Programmatic EIS for Fuel Breaks in the Great Basin. The PEIS analyzes locations and tools that could be used for fuel break projects. Examples of other fuel break projects include the following: ● Tri-State Fuel Breaks Project (1,539 miles of fuel breaks) ● Jarbidge Wildfire Fuel Breaks Project (160 miles of fuel breaks)
Vegetation Management Activities	Future vegetation management activities in the project area include BLM plans like those listed in the past and present actions as well as initiatives by Invasive Plant Councils to develop and implement vegetation management policies at the state and national level. Examples include: ● BLM Fuels Reduction and Rangeland Restoration in the Great Basin (38.5-million-acre analysis area) ● BLM California Hazard Removal and Vegetation Management Project (up to 20,000-acre project area) ● Twin Falls District Vegetation Treatment for Noxious and Invasive Weeds EA (3.9 million-acre project area) ● Sage Hen Flats Fuels Project EA (9,000-acre project area)
Agriculture	The conversion of native habitats to cultivation or dairy/cattle operations is expected to slow or possibly be reduced. According to the USDA's 2017 Census of Agriculture (USDA 2019), the acres of land in farms have decreased in most states in the project area.

Reasonably Foreseeable Future Projects, Plans, or Actions	
Human Actions	
Other Developments, Roads, and Rights-of-Way	Urban development patterns, the continuing growth of vehicle-based recreation, planned road and highway projects, infrastructure and ROW development (such as pipelines, electrical transmission lines, and wind energy projects), and population growth are expected to increase demand for, and construction of, transportation routes in the project area. Continued use of transportation corridors is expected to increase the risk of roadside ignition of wildfires and further spread invasive annual grasses.
Mining and Oil/Gas Leasing	Future mining and oil and gas leasing projects in the project area are expected to continue and, in addition to those projects listed above, include the following: ● The Sienna Hills Mineral Materials Sale ● Coeur Rochester POA 10 Expansion ● Diamond Fork Phosphate Mine ● Dairy Syncline Phosphate Mine ● Caldwell Canyon Phosphate Mine
Recreation	All forms of dispersed, organized, and concentrated recreation would continue throughout the project area. There would continue to be specific management for certain activities per the recreation management allocations in individual BLM resource management plans. Recreation projects, such as building, expanding and maintaining recreation facilities, would continue. Overall visitation to the project area and BLM-administered lands in the project area is expected to increase; however, the number of visitors would vary by season, year, location, and type of activity. WUI areas are expected to have the largest increase in visitation.

Reasonably Foreseeable Future Projects, Plans, or Actions	
Natural Processes	
Spread of Noxious and Invasive Weeds	Noxious and invasive weed species are expected to continue spreading on all lands and increase risk of wildfire. Future management for invasive weeds will help mitigate impacts. The BLM management plans identified in the past and present actions would be expected to continue. In addition, these management plans may change in response to new and improved technology, changed environmental conditions, or new policy regarding the spread of noxious weeds and invasive plants. Invasive Plant Council initiatives and policy as identified above are also expected to continue and evolve to address the spread of noxious weeds and invasive plants.
Wildland Fire and Fuels	The increasing recurrence and severity of drought conditions could, in turn, increase the occurrence, of wildfires in the project area.

Source: BLM Interdisciplinary Team Input

4.2 Vegetation

4.2.1 Assumptions

- The length of time needed to reach the desired condition would depend on site-specific conditions.
- Removal of individuals of desirable species along with the undesirable species may be necessary to prepare an area for seeding.
- Successful restoration treatments would increase the plant communities' abilities to maintain native structure and function (resistance) and increase their ability to recover from disturbances (resilience).
- Restoration success may require a combination of treatments over time.
- Restoration would include treatments to decrease fuel continuity; with clear project objectives, implementation, monitoring, and adaptive management it is expected that invasive annual grasses would not increase in the long-term.

- Monitoring would occur (see **Section 2.2.8,** Monitoring, Maintenance, and Adaptive Management) to ensure original project objectives are maintained and that maintenance and/or adaptive management actions are taken before the integrity of the original project is degraded or lost.
- Impacts on special status plant species are directly correlated to impacts on their associated habitat type or critical habitat. See **Appendix J**, Special Status Species in the Project Area for a crosswalk of species and their habitat associations.

4.2.2 Nature and Type of Effects

General Effects by Treatment Method

Effects from Restoration Projects

Treatments represent a strategic approach to managing threats to sagebrush ecosystems using resistance and resilience concepts, including resistance to invasion, resilience to disturbance, and the predominant sagebrush community threats and likelihood of restoration success based on these factors (Chambers et al. 2014a; 2014b). Treatments would be guided by the science basis and management applications described in the Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior's Integrated Rangeland Fire Management Strategy to Long-Term Strategic Conservation Actions, Parts 1 (Chambers et al. 2017a) and 2 (Crist et al. 2019).

Restoration would remove or modify vegetation to achieve objectives and move towards desired condition. Treatments would change the movement of fire by breaking up fuel continuity and creating a mosaic of vegetation communities across the analysis area. In turn, this would help increase plant community diversity, and improve structure and function. Treatments ultimately would improve vegetative health and resistance and resilience, as the resulting mosaic of vegetation conditions would be less susceptible to dominance by invasive annual grasses (Chambers et al. 2017 p. 103) and future disturbances, including fire. Vegetation would also be closer to its historical character, with a longer fire return interval and a less intense fire seasonality.

Precise effects on vegetation in treatment areas, such as the amount of vegetation removed, length of time needed for vegetation recovery, and potential for invasive plant increases would vary depending on the vegetation state where the project would be carried out, and the proposed treatment method(s). These effects are described below under the effects from each treatment method headings, and the *General Effects by Vegetation State* heading.

In general, and in the short term, restoration projects would alter plant community composition by reducing the biomass, cover, and continuity of flammable vegetation; depending on the plant community, this could include annual and/or perennial herbaceous vegetation, shrubs, and trees. Restoration would also alter plant community structure and function by seeding or planting to move the plant community toward desired condition, including by reducing cover of invasive annual grasses and pinyon-juniper and increasing cover and diversity of native plant species. These changes would occur incrementally over time, especially where multiple treatments were required to achieve desired conditions. Depending on the herbaceous plant community present, pre- and post-treatment invasive plant control may be necessary to meet project objectives. In the long term, the combined effects of rangeland restoration projects would be a more diverse plant community structure, with better functioning nutrient and hydrologic cycling and more vigorous constituent vegetation. These features would indicate a community with increased resistance and resilience (Chambers et al. 2014a). Treatments would help restore degraded, sagebrush communities to a more resistant and resilient condition. Increased resistance to invasive annual grass colonization, and resilience from disturbances, would, in turn, modify wildfire behavior by restoring natural burn patterns and lengthening fire return intervals.

Biological soil crusts stabilize soil, reduce or eliminate erosion, retain soil moisture, and shelter and increase germination success for plant seeds (USFS 2017), affecting vegetation community hydrologic cycling and plant vigor. Thus, when present, these features help to maintain the desired conditions. This effect may be more pronounced at lower-elevation sites. This is because lower precipitation levels and herbaceous vegetation cover promote crust development, making biological soil crusts more prevalent at lower elevations compared to higher elevations. Importantly, biological soil crusts present in warmer and drier sagebrush communities improve the resistance of such ecosystems by reducing the germination and establishment of invasive annual grasses such as cheatgrass (Chambers et al. 2014a). The potential impacts on biological soil crusts from each vegetation treatment method are discussed in **Section 4.6**, Soils. If damaged by treatments, crust recovery times are highly variable, and depend largely on the timing of disturbance and moisture availability. Thus indirect effects on vegetation community condition can be relatively short- or long-term, depending on the type of disturbance to the crust and environmental conditions during and post-disturbance.

Special Status Plants

Impacts from restoration projects on undetected special status plant species would be similar to those described for general vegetation above. Special status species are generally more vulnerable to threats from wildfire and invasive grasses compared with non-special status plants, and therefore would benefit from long-term improvements to surrounding plant communities that decrease these threats (e.g., USFWS 2011). Treatments that increase habitat resistance to invasive annual grass conversion and resilience from disturbances would potentially reduce threats of habitat loss and population reductions or extirpations. This would be true for both treated areas and adjacent untreated areas, which would benefit from reduced potential for wildfire or invasive species spread. Movement toward vegetation states with a more diverse plant community would improve conditions for pollinators; this would benefit special status plants by increasing genetic transfer and potentially reproductive success.

Effects from the treatment methods described below may be magnified for special status plant species due to the rarity, limited extent, and specialized habitat requirements. Many special status plants rely on the security of seed banks for continued propagation; therefore, they are more susceptible to surface disturbances that disturb, reduce, or eliminate seed banks. If multiple treatment methods are used in the same location, the potential for damage or mortality of undetected special status plants could also increase. Some special status plants also rely on specific pollinator species and may, therefore, be affected by vegetation modifications that alter habitat for pollinators and lead to changes in pollinator abundances or assemblages over the short term. Over time, these disturbances would eventually increase the longevity of the community by providing sustenance to pollinators through increased native plant diversity, vigor, and nutrient and hydrologic cycling, all of which balance a plant community's ability to retain a higher resistance and resilience.

To avoid or reduce potential impacts on special status plants during project implementation, avoidance measures through design features (see **Appendix D**) are incorporated into all action alternatives. After avoidance, impacts would primarily be due to the lack of detection of special status plants or their seed banks during pre-project planning. Surveys may not accurately account for annual species because they do not reliably appear every year, so impacts would be greatest for this group of plants. Long-lived perennials and biennials, which are persistent year-round, are more reliably detectable; therefore, impacts on this group would be unlikely. Special status plants occurring in unique habitats (i.e., ash outcrops, playas, and sand dunes) would experience few, if any, impacts, as these habitats are generally easily avoided. As opposed to manual treatments, areas receiving mechanical, prescribed fire, targeted grazing, and chemical treatments would have the greatest impact on undetected special status plants due to the widespread continuous application, soil disturbance, use of heavy equipment, and displacement of special status plants due to the use of introduced species for seeding.

Effects from Chemical Treatments

The effects of chemical treatments on vegetation are described in detail in the Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007, p. 4-44 to 4-76) and the 2016 Final PEIS for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States (BLM 2016a, p. 4-25 to 4-38). As described in those PEISs, which are hereby incorporated by reference, chemical treatments can be used to remove target plants, or decrease target plant growth, seed production, and competitiveness, thereby releasing native or desirable species from competitive pressure and aiding in their reestablishment where vegetation modification is desired. Following standard operating procedures (BLM 2007, Table 2-8) and mitigation measures (BLM 2016a, Table 2-5) described in the PEISs would prevent impacts or reduce impact intensity, including death, reduced productivity, and abnormal growth from unintended contact with chemicals via drift, runoff, wind transport, or accidental spills and direct spraying, on nontarget vegetation. The degree of impact depends on the chemical used and its properties, such as its persistence, the application rate, the treatment method, the physical site conditions, and the weather (such as wind or rain) during treatments (BLM 2007, p. 4-47, Impacts Common to All Treatments). These effects would generally occur during and immediately following treatments.

The effects of chemical treatments on plant pollinators would depend on the chemical used, treatment timing, and plant and pollinator species affected. As described in BLM 2007 (pp. 4-101 to 4-118) and BLM 2016a (pp. 4-39 to 4-41), some chemical formulations can be toxic to pollinators; acute or chronic exposure to these formulations could result in mortality and reduced population sizes, indirectly reducing ecosystem function. Following standard operating procedures and mitigation measures described in the PEISs, such as using lowest effective rates, applying application buffers, and preventing drift, would minimize or prevent these impacts. This would prevent or reduce pollinator mortality and population decline, indirectly maintaining pollination rates and ecosystem function. These measures are consistent with best practices for pollinators on western rangelands (Xerces 2018), such as using formulations that are least toxic to pollinators, using the lowest effective rates, timing application to avoid pollinator exposure, incorporating application buffers, and preventing drift, among others.

Special Status Plants

Chemical treatments would be unlikely to directly affect special status plants due to implementation of avoidance measures through design features (e.g., Design Features 34 and 35, **Appendix D**) and conservation measures described in the BA and the slickspot peppergrass Conservation Agreement (relevant to slickspot peppergrass only). Potential impacts to undetected special status plants and seed banks would be the same as described above for general vegetation. They would depend on the active ingredient and application method. For example, studies have shown that pre-emergent spray of Imazapic at the typical application rate is likely to injure some plants (BLM 2007) and affect the growth of native forbs (Kilkenny et al. 2016).

Based on the type of chemical treatment used, broadcast applications would have the largest impacts on undetected special status plants due to the inability to select for target species. Based on the use of best management practices for pollinators when applying chemical treatments, changes in pollinator assemblages or abundances would indirectly affect special status plants through changes in pollination rates, which could affect reproductive success.

Off-site impacts from chemical treatments would be unlikely, as application must adhere to label restrictions that reduce potential for off-site drift. To reduce the potential for impacts from off-site drift on federally listed plant species, conservation measures in the BA (see **Appendix D.2** in this PEIS) would require establishing buffer zones around special status species. Impacts to special status plants occurring in unique habitats would be avoided because these areas would not be treated.

Design features and adherence to management efforts aimed to protect both plants and their pollinators, as described in Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007, p. 2-28 to 2-31, 4-73), would also reduce the potential for loss of nontarget species and pollinators. Such efforts include designating buffer zones around rare plants; managing chemical drift, especially in the vicinity of blooming plants; using typical rather than maximum rates of chemical treatments in areas with rare plants; choosing chemical formulations that are not easily carried by social insects back to "homes" in areas with rare plants; choosing chemical treatments that degrade quickly in the environment; and timing chemical treatments when pollinators are least active. These efforts would minimize impacts on pollinators to be short term and localized (BLM 2007).

Effects from Manual Treatments

Manual treatments would use hand tools and hand-operated power tools to directly remove or modify vegetation in treatment areas. This, in turn, would change plant community structure and function by reducing percent cover of target species, altering species composition, and altering microsite climatic conditions, such as increasing soil temperature and solar radiation, that could indirectly affect plant vigor. Manual treatments would occur in areas where mechanical equipment use would be unlikely, such as on steep slopes or rocky sites or near sensitive resources. Manual treatments to remove trees could also be used in sites with pinyon or juniper, in combination with mechanical treatments.

Manual treatments would have a low potential to damage or kill nontarget vegetation. This is because workers could easily avoid nontarget vegetation and because the amount of surface disturbance associated with manual treatments is generally localized. Nontarget vegetation may be damaged or killed by foot or vehicle traffic, but this effect would be short term and localized.

Manually removing the shrub canopy in treatment areas could release desired perennial grasses and forbs that are present in the shrub understory (Monsen et al. 2004). Indirectly, this would increase the cover and diversity of understory herbaceous species in the long term.

All prescribed soil disturbance would need to incorporate noxious and invasive weed management, including pre-work evaluation or avoidance and post-work monitoring (including for invasive annual grasses) in accordance with the local weed program and corrective action where needed (Design Features 18 and 19, **Appendix D**). This would reduce or prevent increased cover of invasive annual grasses that may be released by overstory shrub removal (Davies et al. 2011a). Further, monitoring and corrective actions may prevent or reduce increased cover in invasive annual grasses in adjacent untreated vegetation communities by preventing or reducing weed spread into these areas.

Special Status Plants

Impacts on special status plant species from manual treatments would be similar to those described for general vegetation above. Because manual treatments allow for selective vegetation removal, impacts would generally be of low intensity with low vegetation and soil disturbance, and would occur only within the direct footprint of the treatment. The likelihood for injury or mortality of undetected special status plant species would be virtually nonexistent on all categories of special status plants due to localized treatment, targeting of individual plants, and ability to control the level of disturbance. There would be minimal threat to seed banks from burial because manual treatments would be concentrated to small areas within a wider treatment area and limited to soil surface and vegetation disturbance.

Undetected annuals would be most likely to be affected due to their episodic nature and, therefore, the lack of avoidance of those seed banks and plants. Manual treatments could have indirect impacts on special status plants through effects on pollinators; however, manual treatments are unlikely to cause large changes in vegetation communities, so changes in pollination rates would be low.

Effects from Mechanical Treatments

Effects common to all types of mechanical treatments are discussed first, followed by a discussion of effects from specific treatment methods.

Mechanical treatments would remove vegetation and/or prepare and sow seed beds, which would disturb the soil surface. Vegetation removal would be done by vehicles with attached implements designed for vegetation treatments, such as agricultural mowers, masticators, disks and plows, chains and cables, and harrows and imprinters.

Mechanical treatments in vegetation states with a shrub overstory could release desired perennial grasses and forbs (Monsen et al. 2004). Managing invasive plants as described under *Effects from Manual Treatments* would reduce or prevent a similar release of invasive annual grasses in the shrub understory in treatment areas, and also potentially in untreated adjacent vegetation communities.

Depending on the time of year mechanical treatments are conducted, mechanical removal of vegetation that has set seed may aid in dispersing this seed throughout the treatment area. This may increase post-treatment germination rates of the target species. The desirability of this impact would depend on the species and treatment objectives.

Soil disturbance during mechanical treatments would generate airborne dust. Dust settling on nearby vegetation could suppress plant physiological processes (Kameswaran et al. 2019). This, in turn, could suppress pollinator efficiency and thus plant vigor as indicated by reproduction, as described by Waser et al. (2017) in a study of the effects of road dust on nearby wildflower pollination and reproduction. This effect would be most intense on vegetation in close proximity to soil disturbance during treatments when dust would be generated; the magnitude of intensity would decrease with increasing distance from the soil disturbance, and would cease over time as wind and rain blow or wash dust off vegetation.

Tilling would uproot and bury existing vegetation to create a seedbed suitable for desired species establishment. This method is best suited where complete removal of vegetation is desired (e.g., where invasive annual grasses dominate), and would be used in conjunction with chemical treatments and seeding. For example, pre- or post-tilling chemical treatments where invasive plants are present, would reduce invasive plant germination while post-chemical seeding would establish desired vegetation. Without follow-up chemical treatment, the potential for invasive plant cover to increase would be higher (Zouhar 2003), both in the treatment area and in adjacent, untreated areas. Thus, follow-up treatments would be needed to achieve desired conditions.

Harrowing would scarify the soil surface and uproot shrubs, increasing shrub interspaces. The effect intensity would increase with more harrow use in a given area, because more vegetation would be removed with each pass of the harrow. Pre- or posttreatment seeding, or posttreatment planting in interspaces, would promote species and age class diversity. Chemical treatments and seeding would reduce invasive plant germination and prepare and sow the seedbed for desired species establishment. Plant debris would remain on-site, facilitating moisture retention and nutrient cycling, which could aid the revegetation effort.

Chaining would scarify the soil surface and uproot and break off shrubs and trees, thereby reducing shrub and tree cover, preparing a seedbed, and covering broadcast seed. Where a threat of invasive annual grasses occurs or are currently present, pre- or post-chaining chemical treatments and seeding would reduce invasive plant germination and prepare and sow the seedbed for desired species establishment. Chaining can be adjusted by the appropriate season (for example, avoiding treatments when soils are dry and loose) to improve seeding success and desired species establishment (Monsen et al. 2004). Where invasive plant species are present, follow-up chemical treatments would reduce invasive plant germination, helping to more quickly move vegetation toward desired conditions.

Imprinting would create microsites conducive to seedling establishment. This would improve seedling establishment, and help to more quickly move vegetation toward desired conditions.

Mowing would cut herbaceous and woody vegetation above the soil surface, to reduce fuel height. To maintain a reduced fuel load, mowing would be repeated as herbaceous biomass or shrub canopies regrow and exceed the desired height. Mowing could increase the potential for the release of both desired perennial grasses and forbs (Monsen et al. 2004), and invasive annual grasses (Davies et al. 2011a), that are present in the shrub understory. As described above, follow-up chemical treatments could be used to reduce invasive plant germination, which would help to more quickly move vegetation toward desired conditions. Following mowing best practices for pollinators on western rangelands (Xerces 2018), such as using rotational mowing practices and avoiding mowing during vulnerable pollinator life stages, would protect and maintain plant pollinator populations during mowing treatments, indirectly facilitating movement toward desired conditions by maintaining plant reproductive vigor.

Mastication would shred pinyon and juniper trees to decrease further encroachment. Mastication would remove woody vegetation, having similar impacts as mowing. A vehicle attached to the masticator can damage nontarget vegetation in the short term by crushing it. The amount of damage would vary by the type of vehicle used, though crushed vegetation would likely recover over one to several growing seasons. Treatment areas could be seeded before mastication, and mulch generated during treatment left in place would aid in seed incorporation, germination, and establishment.

Special Status Plants

Impacts from specific mechanical treatment methods, as described for general vegetation above, could occur on all undetected special status plant species; special status plants occurring in unique habitats would be avoided. Mechanical treatments that involve broadcast methods would potentially remove undetected special status plant species due to the inability to be selective toward the target vegetation and the heavy machinery that is involved in implementing these treatments (Benton et al. 2016). Plant mortality and seed burial are likely to occur where there is deep soil surface disruption (e.g., from tilling and seeding/planting). Destruction of special status plant seed banks would be particularly harmful to species with seeds that remain viable in the soil for long periods of time before germinating. Conducting appropriately timed surveys within suitable or potential habitat (Design Feature 34) would limit the chance of individuals and seed banks being undetected and occurring in a treatment area; however, due to the size and continuity of the treated area, surveys may not capture all individuals, particularly annuals that are not visible year-round or even every year.

Removal of large areas of vegetation via mechanical treatments would affect conditions for pollinators over the short term. Follow-up seeding and planting would eventually restore cover and diversity of native plant species that would support pollinator species associated with native plants. Changes in pollinator assemblages or abundance could influence special status plants by changing pollination opportunities and rates.

Effects from Prescribed Fire Treatments

Prescribed fire would be used under specific weather and wind conditions to remove plant biomass and create a seed bed for revegetation treatments. When combined with other treatments, prescribed fire can help move vegetation toward desired conditions by improving seed bed conditions and facilitating desired vegetation establishment. For example, in areas with high invasive annual grass cover, prescribed fire would reduce the residual biomass to create a clean surface for subsequent herbicide application. This would reduce competition with seeded or planted desired species. Removing aboveground biomass can also release existing perennial grasses and forbs by freeing resources for growth (Monsen et al. 2004).

Heat generated during prescribed fire treatments can damage or kill existing desired vegetation; the amount of damage would depend on the species, its ability to withstand fire or regrow following fire, and fire timing. Prescribed fire would be most likely to occur outside most species' active growth period, when low biomass moisture levels would facilitate prescribed fire objectives. Consequently, because prescribed fire tends to be most damaging to plants during their active growth period, desired vegetation damage would be minimized.

Most grasses tolerate fire well unless they have dense tillers or litter and standing dead material around the grass crown (Miller et al. 2014). The relative tolerance of woody plants and forbs to fire is variable. Shrubs like rabbitbrush that resprout after fire are tolerant while forbs such as sandwort (*Arenaria* spp.) with growing points aboveground are intolerant. Sagebrush species tend to have a high mortality rate following fire (Miller et al. 2014; Monsen 2004), and bitterbrush does not recover well after repeated burning (Busse and Riegel 2009).

The potential that higher heat from prescribed fire in pinyon-juniper vegetation states due to denser, larger fuels would alter the physical, chemical, and biological properties of the soil would be relatively low when burning small piles and potentially higher when burning larger piles or piles containing large pieces of wood (Busse et al. 2013; Rhoades et al. 2015). In the latter case, long-lasting alterations in soil nutrient availability and porosity can suppress future vegetation or influence species composition (Busse et al. 2010, 2013). This effect is unlikely to occur during broadcast burning but is more likely during pile burning.

Establishing a fire line during certain prescribed fire operations may be necessary and would temporarily remove existing vegetation where the line was established. Constructing hand lines involve physically scraping or digging with hand tools to bare mineral soil. Hand lines would generally be 1 to 3 feet wide, depending on existing vegetation. Follow-up chemical and revegetation treatments would reduce or prevent localized increases in invasive grass germination in fire lines. These impacts would not occur when a wet line was used because no vegetation removal or soil disturbance would occur using this method.

Developing and implementing a prescribed fire burn plan in accordance with the PMS-484 Interagency Prescribed Fire Planning and Implementation Procedures Guide (NWCG 2017) would reduce the potential for prescribed fire to escape the treatment area and cause unintended damage to nontarget vegetation. Further, plans would ensure that prescribed fire would be conducted in appropriate treatment areas. For example, broadcast burning should be avoided in low-elevation, intact sagebrush areas, as it would likely create conditions conducive to cheatgrass invasions (BLM 2003).

Pollinator response to fire, including prescribed fire, would vary by pollinator species. Direct injury or mortality of pollinators could occur if prescribed fire is conducted during sensitive pollinator life cycle periods, such as the egg or larval stage when individuals are immobile. Mobile species may be able to vacate the prescribed fire area to avoid injury or mortality. Design Feature 10 (**Appendix D**), burning debris piles when soils are wet or frozen, is consistent with prescribed fire best practices for pollinators on western rangelands (Xerces 2018), including dormant season burning and avoiding high-intensity fire. This measure would reduce or avoid direct pollinator injury or mortality from prescribed fire during sensitive pollinator life cycle periods.

Special Status Plants

Known occurrences of special status plants would generally be avoided unless the species is fire adapted. Prescribed fires could kill undetected individuals or kill seeds in the upper soil layers. Many species of special status plants occur in unique soils or topography that are easy to identify and avoid. Prescribed fire during the active growth period would be most damaging to undetected special status plant species, but treatments would most likely occur when plants are dormant, thereby reducing potential for damage to live plants. However, special status plants such as slickspot peppergrass, which tends to be dormant for the majority of its life space, would be more difficult to detect.

Burning in cooler, moister conditions would reduce fire intensity and increase survival of undetected special status plants and their seed banks. Heat-induced impacts on physical, chemical, and biological soil properties would affect conditions for future vegetation communities (Busse et al. 2010) and potentially alter conditions for special status plants and seed banks that rely on microhabitats with unique conditions.

Prescribed fire would alter conditions for pollinators from the removal of aboveground biomass. Vegetation would eventually be restored through follow-up seeding and planting, and treated areas would support pollinators that associate with the desired vegetation state. Changes in pollinator assemblages or abundance could influence pollination opportunities and rates for special status plants.

Effects from Targeted Grazing Treatments

Targeted grazing would primarily be used to reduce fuels from invasive annual and nonnative perennial grasses. A variety of species (cattle, sheep, and goats) could be utilized depending on site conditions and treatment objectives. The effects would vary depending on the grazing intensity (i.e., the number of head), species of livestock, class and type, grazing season and frequency (see below), and resistance of target vegetation to livestock grazing (Heitschmidt and Stuth 1991). In the short term, applying growing-season targeted grazing on invasive annual grasses where they are dominate and perennial vegetation is lacking would reduce invasive annual grass vigor by reducing plant growth, seed production, and species recruitment.

Foraging behavior and associated impacts on vegetation differ by species, but are commonly separated into three categories: grazers, intermediate feeders, and browsers (Burritt and Frost 2006). Cattle are grazers because they have the ability to consume large quantities of low-quality forage but lack the selectivity of browsers when consuming forage. Sheep are intermediate feeders because they have the ability to be selective with their diet, but, like cattle, still have the ability to consume lower quality forage. Goats are browsers because they can be selective with their diet but cannot consume low quality forages that cattle consume (Burritt and Frost 2006). Timing and frequency of grazing have variable impacts to both target and nontarget species. For example, grazing invasive annual grasses during the late winter or early spring would reduce aboveground biomass and current year seed production through herbivory and trampling (Mosley and Roselle 2006). However, spring grazing that requires multiple grazing events to meet treatment objectives for fine fuels, may impact native vegetation that is present within the treatment area. This effect on native vegetation would be more pronounced for native bunch grasses that have initiated growth and would intensify the later into spring the grazing treatment occurs. Dormant season grazing of invasive annual grasses in late fall or winter does not prevent or reduce that season's contribution to the seed bank, but it reduces mulch accumulations. Further, dormant season targeted grazing where invasive annual grasses co-dominate with perennial grass and forbs could reduce invasive annual grass vigor, while simultaneously improving perennial grass and forb vigor by providing opportunities for increased plant growth, seed production, and recruitment (Mosley and Roselle 2006). This would come about by freeing resources used by invasive annual grasses, reducing the amount of invasive annual grass seed, and reducing biomass (thatch) that suppresses desirable plant growth and seed germination. After targeted grazing, fuel continuity would be reduced for the following one to several seasons, which can enhance seedling establishment of perennial plant species (Mosley and Roselle 2006).

Targeted grazing may contribute to habitat degradation through utilization of nontarget herbaceous species; however, vegetation states where targeted grazing could occur[3] have already had some type of disturbance, so additional impacts on nontarget vegetation in these areas from livestock would be reduced. As described in **Section 4.6**, Soils, effects from surface disturbance during targeted grazing may be greater when biological soil crusts are present; however, biological soil crusts are often missing or greatly reduced in vegetation states where targeted grazing could occur.

Targeted grazing would reduce aboveground biomass, altering pollinator habitat conditions. Since targeted species would mainly be invasive annual and nonnative perennial grasses in previously disturbed vegetation states, reductions in these species and increases in native perennial forbs and shrubs through

[3] Generally, vegetation states containing moderate to high amounts of invasive annual grasses and introduced perennial grasses (**Section 2.3.5**).

restoration would increase plant community diversity, in turn increasing pollinator habitat quality over time. Incorporating livestock grazing intensity, duration, utilization, and timing best practices for pollinators on western rangelands (Xerces 2018) would help maintain existing pollinator habitat in treatment areas when present. This would help maintain pollinator populations which would facilitate movement toward desired conditions in restored areas.

As a result of the above impacts, targeted grazing could indirectly protect adjacent vegetation communities from the effects of fire and invasive species spread, which could help to maintain current conditions in these areas.

Special Status Plants

Impacts on special status plant species from targeted grazing would be similar to those described for general vegetation above. Undetected special status plants could be trampled or foraged. The widespread continuous application of targeted grazing could lead to soil disturbance from trampling, which may damage seed banks.

For all special status plants, impacts on those species occurring in unique habitats would be avoided. Impacts would be minimized by adhering to a targeted grazing plan that would optimize successful reduction or eradication of target nonnative species, while avoiding damage to native desired plants (Design Feature 15 in **Appendix D**). Targeted grazing would be managed to conserve suitable habitat conditions for special status species, while implementing rangeland health standards and guidelines (Design Feature 16 in **Appendix D**).

Reduction in aboveground biomass through herbivory would alter conditions for pollinators. This could alter pollination opportunities and rates for special status plants. Since targeted species would mainly be invasive annual grasses in previously disturbed vegetation states, reductions in these species would allow a more diverse plant community to be established, which would increase the diversity of pollinator species over time.

Reductions in fuel continuity and movement toward vegetation states with increased perennial grasses would benefit special status plants occurring in adjacent vegetation communities, reducing the potential for habitat degradation from wildfire and invasive species.

Effects from Revegetation Treatments

Revegetation using seeds and seedlings would increase the cover and diversity of desired species. These changes in plant community structure, and resulting changes in plant community function, would occur incrementally over time. Intermediate plant community characteristics would be present until desired conditions are achieved.

Reestablishing perennial vegetation which has been allowed to develop robust root systems would effectively compete with invasive annual grasses by reducing available niches in the soil profile. This would help decrease invasive annual grass prevalence in treated areas over time, and potentially in adjacent untreated areas. Overall, this would contribute to long-term improvement of the plant community and hinder the annual grass invasion-wildfire cycle (D'Antonio and Vitousek 1992; Brooks et al. 2004).

To best meet project objectives, revegetation plant selection would be decided at the site level using BLM Handbook 1740-2. In accordance with the Handbook (BLM 2008, p. 87), the BLM would prioritize native plant material for revegetation. Revegetation objectives can be met using some native species under certain environmental conditions (Rowe and Leger 2010, Larson et al. 2017). Nonnative plants could be used when the natural biological diversity would not be diminished by nonnative species, when nonnative species could be confined to the treatment areas, when site inventory indicates a site would not support native species reestablishment, or when resource objectives could not be met with native species.

The BLM would also follow guidance from the National Seed Strategy for Rehabilitation and Restoration, which guides the development, availability, and use of seed for restoration. The BLM adheres to guidance set forth in this document and would plan restoration projects needing native seed in advance, thereby increasing the likelihood that native seed would be available for revegetation.

Various types of seeding treatments would be used in combination with mechanical and other treatments. Initial localized soil disturbance and damage to existing vegetation in treatment areas from seeding would be similar to those discussed for mechanical treatments. Over time, seeding treatments would increase the cover of desired vegetation, and help to more quickly move vegetation toward desired conditions.

Interseeding or interplanting treatments with forbs and shrubs would increase vegetation diversity and improve the habitat for pollinators, which require pollen- and nectar-rich forage resources (Xerces 2017). Incorporating other restoration best practices for pollinators on western rangelands (Xerces 2018), such as considering pollinators during plant material, site, and planting method selection, would improve pollinator habitat in treatment areas. This would indirectly speed movement toward desired conditions in restoration treatment areas.

In some cases, seeded species may spread into adjacent vegetation (McArthur et al. 1990; Gray and Muir 2013), altering the species composition of those areas. The potential for this impact, and whether the impact is beneficial or detrimental to existing vegetation, would depend on the seeding method proposed (e.g., drill seeding versus broadcast seeding), the species seeded (see H-1740-2), and existing vegetation conditions in adjacent untreated areas.

Overall, revegetation would incrementally move plant community structure and function toward desired conditions by increasing community diversity and function, nutrient and hydrologic cycling, and plant vigor. This would promote maintenance of a more competitive plant community and reduce the threat of invasion by invasive plants. Over time, this would reduce available fuels during fire season, aid in restoring natural burn patterns and lengthening fire return intervals, and aid in increasing the resistance and resilience of treated areas.

Special Status Plants

Impacts on special status plant species from revegetation would be similar to those described for general vegetation above. Short-term impacts from the use of tools to implement revegetation are described under treatment-specific sections and would mainly apply to undetected special status species, seed banks, and pollinators. Special status plants would likely benefit from long-term alterations to the surrounding vegetation community. Movement toward desired vegetation states would increase biological and structural diversity. These changes would reduce threats to special status plant species (including those occurring in areas adjacent to treatment areas), such as potential loss of populations and habitat to wildfire and competition with invasive species, thereby aiding in recovery. They would also improve conditions for pollinators, thereby increasing pollination opportunities for special status plants.

General Effects by Vegetation State

In the **Invasive Annual Grasses** and **Invasive Annual Grasses and Shrubs** vegetation states, reduction of invasive annual grass cover would be necessary to temporarily reduce continuous fuel loading and provide short-term protection to adjacent vegetation states or communities. Coupling the reduction of invasive annual grasses with active restoration would decrease rapid recolonization of invasive annual grasses into the treatment area, reduce the continued suppression of native plant growth and seed production, and therefore, enhance recruitment of native plant species. Conversely, restoration treatments combining invasive annual grass cover reduction with seeding or planting desired species, would move these vegetation states towards the desired condition. Management strategies for invasive annual grasses would incorporate guidance from Tables 5.1 and 5.2 in Crist et al. (2019, pages 95-96) as decision support tools. Reducing invasive annual grass cover would facilitate restoration efforts by decreasing invasive annual grass competition with desired species, directly improving success. Successful restoration would increase native plant diversity, as well as structural complexity, including stems, roots, leaf litter, and standing dead material, and would increase nutrient and hydrologic cycling. In turn, plant vigor would be increased, as expressed by increased native plant growth, seed production, and recruitment. The relative speed and efficacy of movement toward desired conditions would vary depending on the treatment method or combination of treatment methods, as described above in the *Nature and Type of Effects*.

During treatments in these vegetation states, existing vegetation, including remnant desirable species, could be removed to prepare the site for planting desirable species. Multiple treatments may be needed to successfully establish sagebrush and desired perennial grasses and forbs, and to decrease the likelihood of invasive annual grass recolonization and noxious weed spread.

Over time, plant communities would become more diverse, with increased plant vigor, and improved nutrient and hydrologic cycling. This would result in communities with decreased fuel loading and continuity, lessening the potential for risk of loss from wildfire. Restored communities surrounded by invasive annual grasses would continue to be at risk of invasion or frequent wildfire spreading from those degraded areas.

Restoration treatments would be unlikely to occur in the **Perennial Grasses and Forbs** and **Perennial Grasses, Forbs, and Shrubs** vegetation states because they generally represent intact vegetation communities of the desired condition for vegetation treatments in the PEIS. As a result, the ability of these vegetation states to resist invasive annual grass invasion and recover from natural disturbances like wildfire would remain intact. The exception for treatment is that if a vegetation state shows a functional plant group is decreasing or diversity is lacking, revegetation through planting could be implemented to improve diversity and function. Additionally, large areas dominated by perennial grasses and forbs, but lacking shrubs, could be augmented with shrub planting to provide a seed source for shrub expansion and movement towards the desired condition of the **Perennial Grasses, Forbs, and Shrubs** vegetation state. In the **Nonnative Perennial Grasses and Forbs** vegetation state, treatments could focus on reducing the cover of seeded nonnative perennial grasses, and replacing this vegetation with native perennial grasses, forbs, and shrubs. Any treatments in these vegetation states would increase plant community diversity, which directly corresponds to improved plant vigor and nutrient and hydrologic cycling from increased above- and below-ground plant structural complexity, primarily from an increase in shrub cover. In turn, native plant vigor would increase. The improved plant community function over time, would provide better community resistance to invasion and resilience from disturbance like wildfire.

In the **Perennial Grasses, Forbs, and Invasive Annual Grasses** and **Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses** vegetation states, temporary fuels reduction via invasive annual grass treatments would provide the opportunity to move the vegetation states toward the desired condition by seeding or planting desired species. Effects would be similar to those described for the **Invasive Annual Grasses** and **Invasive Annual Grasses and Shrubs** vegetation states, including that multiple treatments may be needed to make progress toward restoration and to prevent invasive annual grass recolonization. However, movement toward desired condition may occur faster, because the existing desired vegetation would be invigorated from the reduced competition for resources with invasive annual grasses and better able to contribute a seed source for passive revegetation.

In the **Shrub with Depleted Understory** vegetation states, restoration treatments would break up homogeneous shrub stands, creating a mosaic vegetation pattern, increasing shrub interspaces, and thereby decreasing fuel continuity and the associated risk of larger fires. Seeding or planting treatments in newly-created shrub interspaces would provide movement towards desired condition by increasing native plant diversity and structural complexity, nutrient and hydrologic cycling, and native plant vigor.

Vegetation state edges can be transition zones between pinyon-juniper woodland and sagebrush communities. When ecological function of the plant community is balanced, there is a natural ebb and flow of pinyon-juniper encroachment within the transition zone that is mitigated by the natural fire return interval. Pinyon-juniper naturally spreads into sagebrush and perennial grass communities (Crist et al. 2019). The naturally more frequent occurrence of wildfire in sagebrush communities (verses pinyon-juniper woodlands) periodically removes encroaching pinyon-juniper. This ebb and flow along the margins of the sagebrush and grassland communities provides valuable habitat to a variety of species but also reduces the value of those areas for sagebrush and grassland dependent species when pinyon-juniper are not periodically removed by a natural wildfire cycle. Wildfire suppression and historic grazing practices have reduced the role of wildfire in these transition areas allowing encroachment of pinyon-juniper beyond what is expected to occur naturally.

Restoration treatments in all Pinyon-Juniper vegetation states would reduce encroachment in the transition zones between woodlands and sagebrush communities. Treatments within the **Pinyon-Juniper Phase I** vegetation state would decrease the likelihood of transitioning to Phase II and Phase III canopy cover. Where adjacent understory vegetation states are intact, Phase I pinyon-juniper removal would enhance the opportunity for natural expansion of the understory. This would occur as resources such as nutrients and water, normally taken up by the encroaching species, are released in local areas where trees are removed. Treatments in the **Pinyon-Juniper Phase II** and **Pinyon-Juniper Phase III** vegetation states would reduce fuels from encroaching pinyon-juniper and standing dead trees, and in turn reduce the risk of large or high-severity crown fire associated with higher tree densities. Where pinyon-juniper treatments are to occur near degraded adjacent understory vegetation (e.g., areas with an invasive annual grass component) restoration via seeding and planting along with weed control would be necessary to minimize the potential for localized establishment or increase of invasive annual grasses or other nonnative species due to surface disturbance (Jones 2019).

Tree removal treatment methods would be chosen and designed to facilitate understory restoration, speeding movement toward desired conditions. For example, mulch or slash from mastication or chaining could be left in place to improve seeding success in newly-prepared seedbeds. Broadcast burning could be used to remove trees and prepare a seedbed where sagebrush understory is depleted; but burning would be less likely to occur where sagebrush understory is intact, since this would remove a seed source for desired vegetation and thus slow movement toward desired conditions.

Understory disturbance related to pinyon-juniper removal would be restored in accordance with the associated adjacent vegetation state. For instance, in greater sage-grouse habitat (see **Section 4.7**, Wildlife), the desired condition would be Perennial Grasses, Forbs, and Shrubs, while thinning to resemble clumps or stringers of pinyon-juniper would be desired in mule deer winter range outside of greater sage-grouse habitat. In such cases, residual pinyon-juniper would be sparse, so the associated risk of fire from remaining trees would be low.

Special Status Plants

Special status plant species may be found in one or more vegetation states and impacts on vegetation states as described above would in turn affect special status plant species found there. The initial use of treatments in any vegetation state in which an undetected special status plant or seed bank occurs may adversely impact such undetected special status plants or seed banks.

An eventual increase or improvement in a vegetation state with which a special status plant species is associated would provide potential habitat and increase the ability of an area to support future populations of that species. In general, plant species associated with grassland habitats would benefit from reductions in invasive annual grasses and movement of vegetation states toward those with native perennial grasses. Species associated with sagebrush habitats would benefit from shrub planting and movement of vegetation states toward those containing shrubs and forbs. The overall desired condition, a mosaic of the Perennial Grasses, Forbs, and Shrubs and Perennial Grasses and Forbs vegetation states, would support both grassland and shrubland associated species. Increasing plant community diversity in all vegetation states would provide habitat conditions that may better support pollinators and special status plant species. See **Appendix J**, Special Status Species in the Project Area, for a crosswalk of species and their habitat associations.

Special status plants that occur in adjacent vegetation communities would benefit from restoration efforts that improve the resistance and resilience of treatment areas, which may lead to the indirect benefit of reduced potential for wildfire and invasive species spread. This would help to reduce threats and maintain current conditions in these areas. In particular, special status plants occurring in areas adjacent to treatment areas that are moved from vegetation states with invasive annual grasses to states with increased perennial vegetation would be at a lower risk of habitat loss and competition.

4.2.3 Effects from Alternative A

Rangeland restoration treatments would not be implemented using this region-wide analysis; individual and potentially large-scale fuels reduction and rangeland restoration projects would likely still occur. Individual projects would generally reduce sagebrush community losses from wildfire, and move vegetation communities toward desired conditions by improving plant community diversity, nutrient and hydrologic cycling, and plant vigor. Without a region-wide approach, however, such projects would occur on an individual basis; thus fewer projects may occur, and planning and implementation would likely take longer.

With fewer projects occurring, and a slower response to project planning and implementation, current ecosystem trends and processes, as described in **Chapter 3**, would likely continue. These include reduced sagebrush community resistance and resilience from increases in invasive annual grasses and pinyon-juniper encroachment. Conversion to cheatgrass and other invasive annual grasses, which increase the presence of fine fuels and threaten sagebrush communities from fire, would likely continue at a similar rate. These changes in wildfire regime have caused degradation and loss of sagebrush habitats and have altered and simplified plant communities, leading to increased homogeneity of landscapes (Balch et al. 2013; West 2000). There would be a continued trend toward conversion of sagebrush communities to one dominated by invasive annual grasses, eventual loss of native plant diversity, and movement away from desired conditions in the analysis area, particularly in areas with lower resistance to invasion and lower resilience from disturbance such as wildfire.

Special Status Plants

Under Alternative A, individual fuels reduction projects would reduce the loss of habitat for special status plants to wildfire, while restoration projects would improve plant diversity and structure and thus pollination opportunities. The response, however, would likely be slow due to a slower response to site-specific vegetation treatments, and habitat alterations would likely lack landscape continuity due to a lack of region-wide planning. Current habitat trends would continue to some extent, including changes in wildfire regimes, invasive annual grass expansion, and pinyon-juniper encroachment. Increased homogeneity and the loss of native plant diversity would decrease the occurrence of unique microhabitats occupied by many special status plants, decrease pollinator diversity, and potentially decrease pollination opportunities. Where carried out, individual fuels reduction and restoration projects incorporating best practices for pollinators on western rangelands (Xerces 2018) would help maintain and improve pollinator habitat in treatment areas, helping to maintain or improve vegetation community structure and function.

4.2.4 Effects from Alternative B

The potential treatment area under Alternative B (~ 38.5 million acres) consists of the current and historic extent of sagebrush on BLM-administered lands without the exclusion analysis areas (**Section 2.1.1**). While treatments may occur anywhere within the potential treatment area, most treatments are expected to occur within the 26.3-million-acre emphasis area that lies within the potential treatment area (**Section 2.4.2** and **Map 2**). All treatment methods to improve degraded conditions would be allowed in this alternative although there are restrictions by vegetation state as described in **Table 2-1**.

In all vegetation states, treatments would be prioritized in areas of low to moderate resistance and resilience to indirectly protect and conserve adjacent intact sagebrush communities of higher resistance and resilience. This approach would allow for treating degraded areas adjacent to intact sagebrush communities as a means of protection while simultaneously promoting connectivity between high value resource areas and promoting a natural heterogeneity across the landscape. In high resistance and resilience areas, treatments would be limited to increasing native perennial grasses, forbs, or shrubs (**Table 2-1**).

Treatments to restore sagebrush communities would temporarily disturb vegetation and/or soils. The direct and indirect effects of each treatment method are described in **Section 4.2.2**, Nature and Type of Effects. The following is a brief recap of treatment methods followed by a discussion of nuances by vegetation state.

Chemical treatments would remove or reduce target plants; which would reduce competition with desirable vegetation. Chemical treatments would also reduce fuel loading in vegetation states with invasive annual grasses (**Table 2-1**). Nonnative perennial grasses may be removed and replaced with native perennial grasses and forbs in the Perennial Grasses and Forbs vegetation state. In the Shrub with Depleted Understory vegetation state, chemical treatments could be used to remove or reduce invasive species prior to revegetation or thin dense sagebrush to facilitate establishment of perennial grasses, forbs, and shrubs.

Manual treatments would directly remove or modify target species with minimal soil disturbance. In areas where perennial grasses, forbs or shrubs are reduced, additional desirable vegetation could be established via hand seeding or planting methods. Manual treatments could be performed in all vegetation states (**Table 2-1**) but are most likely to be used where sensitive resources occur, plant community diversity is a priority, or soil disturbance should be avoided. For example, manual treatments may be most effective in areas where all functional plant groups (perennial grasses, forbs, shrubs) are present and invasive annual grasses or pinyon-juniper have the least influence.

Mechanical treatments remove or reduce vegetation and decrease fuel loading. The resulting soil disturbance could support seedbed preparation or cover seeds after planting. Treatments may occur in all vegetation states especially in those that are degraded and require the most input to restore, such as Invasive Annual Grasses, Invasive Annual Grasses and Shrubs, and Pinyon-Juniper Phases II and III (**Table 2-1**). Mechanical treatments would avoid highly resistant and resilient areas when possible.

Prescribed fire could be used to remove above ground biomass and, where needed, improve seedbed conditions for restoration (**Section 4.2.2**, Nature and Type of Effects). Prescribed fire would be a particularly effective tool in areas with dense invasive annual grasses or pinyon-juniper due to high fuel loading in those areas (**Table 2-1**). The Shrub with Depleted Understory vegetation state could also be treated with prescribed fire to reduce continuous canopy cover of shrubs and create a mosaic similar to the desired condition. This would provide a native seed source for shrub regeneration.

Targeted grazing of invasive annual and nonnative perennial grasses would reduce the amount of aboveground biomass through eating and trampling which temporarily decreases fuel loading and continuity. Implementation would be limited to areas where invasive or nonnative perennial grasses are dominant or codominant in the vegetation states (**Table 2-1**).

Revegetation would increase the cover and diversity of desired species. Through seeding and seedling planting, vegetation would be established on sites where it has been previously lost or removed. This could occur in all vegetation states, with the most broad-scale application likely to occur in vegetation states lacking either perennial grasses or shrubs; such as Invasive Annual Grasses, Invasive Annual Grasses and Shrubs, and Shrub with Depleted Understory. Smaller scale treatments could occur in vegetation states where perennial grasses, forbs or shrubs are reduced and native species augmentation is necessary to improve plant community function. For example in the Perennial Grasses, Forbs, Shrubs and Invasive Annual Grasses vegetation state, after invasive annual grasses have been treated for removal, revegetation using mechanical or manual methods could take place.

Seedbed preparation is a part of most restoration treatments and involves the removal of undesirable vegetation and usually some soil surface disturbance to improve germination and establishment of desirable seeded species. Seedbed preparation may remove some remnant desirable species and if the seeded species don’t establish well, undesirable species may quickly recolonize the area. All restoration treatments disturb the plant community to some degree and could temporarily reduce desirable vegetation or increase undesirable vegetation.

In the **Invasive Annual Grasses** and **Invasive Annual Grasses and Shrubs** vegetation states, all treatment methods could be used to remove invasive annual grasses and revegetate these areas with perennial grasses, forbs, and shrubs. Follow-up chemical treatments would extend this effect by reducing subsequent invasive annual grass germination. This reduction would increase success of revegetation by reducing competition between invasive annual grasses and desirable species. Broadcast burning in these vegetation states during the dormant season, with follow-up chemical treatments, would temporarily reduce biomass and seed production of invasive annuals. Given the degraded nature of the invasive annual grass vegetation states, restoration would likely take multiple treatments over multiple years, with successive treatments incrementally moving vegetation towards the desired condition. Where nonnative perennial vegetation is used for restoration, this would stabilize sites until adequate technology or funding for full restoration using native species is available.

Typically, no treatments would be needed in the desired condition vegetation states, **Perennial Grasses and Forbs** and **Perennial Grasses, Forbs, and Shrubs**. The exception is where perennial grasses, forbs or shrubs are reduced (**Table 2-1**) or where nonnative perennial grasses (seedings) would be converted to native perennial grasses. The latter treatment would use targeted grazing and chemical treatments for the conversion to native species.

In the **Perennial Grasses, Forbs, and Invasive Annual Grasses** and **Shrubs, Perennial Grasses, Shrubs, and Invasive Annual Grasses** vegetation states, treatments would preserve intact perennial vegetation while suppressing invasive annual grasses and where necessary interplanting perennial grasses, forbs or shrubs that are decreasing or where diversity is lower than expected. Where invasive species dominate, preemergent chemical and targeted grazing treatments would reduce continuous fuel loading. Preemergent chemical treatment of invasive annual grasses would likely be preferred over targeted grazing in order to reduce direct impacts on nontarget, native vegetation from trampling, herbivory, or browse. Chemical application would be strategically designed to target specific species (e.g., cheatgrass) and avoid others (e.g., native forbs and perennial grasses) through application timing and different herbicide modes of action. Targeted grazing could be considered when invasive annual grass cover is on the higher end for this vegetation state (**Appendix F**, **Table F-1**) and biological soil crusts (see **Section 4.6**, Soil Resources) are absent or not well developed, because in this case, direct impacts on these features would be minimized or avoided. There would be no effects from prescribed fire, because this treatment method would not be allowed in these vegetation states.

All treatment methods could be used in the **Shrub with Depleted Understory** vegetation state to remove invasive annual grasses and restore perennial grasses, forbs, and shrubs. Treatments would decrease fuel continuity by thinning shrubs. This would reduce the potential for loss of large sagebrush stands by wildfire. Because depleted understory vegetation is typically inadequate to recover passively, seeding or planting would establish a perennial herbaceous understory in shrub interspaces.

In areas of **Pinyon-Juniper Phase I** encroachment, manual, mechanical, and prescribed fire (pile burn, jackpot burn, or broadcast burn) treatments would remove encroaching trees. As described in the *General Effects by Vegetation State* header in **Section 4.2.2**, treatments would reduce tree encroachment and likelihood of transitioning to **Pinyon-Juniper Phase II** or **Phase III**. Manual, mechanical, and prescribed fire treatments, as well as seeding in areas disturbed by treatments in the **Pinyon-Juniper**

Phase II and **Phase III** vegetation states would restore a diverse plant community with improved nutrient and hydrologic cycling. Effects from pinyon-juniper treatments would depend on wildlife habitat considerations. In greater sage-grouse habitat (see **Section 4.7**, Wildlife and Special Status Wildlife), pinyon-juniper would be removed to enhance the habitat, while in areas where sage-grouse use is unlikely, tree stringers, groups, or clumps may be left in place as mule deer habitat. Outside sage-grouse habitat, not all **Pinyon-Juniper Phase I** would be treated, and, **Pinyon-Juniper Phase II** or **Phase III** would be thinned while retaining adequate hiding and thermal cover. In such cases, residual pinyon-juniper would be sparse. This, combined with improved community resistance and resilience, would mean that the associated risk of fire from remaining trees would be low.

In all vegetation states, implementing design features (**Appendix D**) would minimize direct treatment effects on native and desirable vegetation to the extent practical, and help to move treated areas toward desired conditions more quickly. Design features to reduce effects on vegetation from manual and mechanical treatments would include placing equipment in previously-disturbed areas (Design Feature 2), applying applicable land use plan and resource-specific buffer distances (Design Feature 3), implementing weed management to prevent or minimize weed spread (Design Features 18 and 20), avoiding disturbance to trees with old-growth characteristics (Design Feature 22), and minimizing activities in erosive soils (Design Feature 29), on steep slopes (Design Feature 30), and when soils are saturated (Design Feature 31). By incorporating these features into project design, soil disturbance, and thus the potential for invasive annual grass and noxious weed establishment in treatment areas, would be decreased. Monitoring and control of weeds post-treatment (Design Feature 19) would reduce the potential that weed cover would increase in adjacent untreated areas. Using locally adapted or genetically appropriate seed species (Design Feature 21) would enhance restoration efforts and speed progress toward objectives.

Additional design features would be incorporated for targeted grazing (Design Features 15–17) and prescribed fire (Design Features 9–14), minimizing potential indirect effects like physical damage to or removal of nontarget vegetation in and adjacent to the treatment area. Further, as described under *Effects from Chemical Treatments* in **Section 4.2.2**, Nature and Type of Effects, the potential impacts on nontarget vegetation from chemical treatments would be reduced by adhering to standard operating procedures and mitigation measures from the Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement and Record of Decision (BLM 2007, PEIS Table 2-8 and Record of Decision Appendix B) and the Final PEIS on using Aminopyralid, Fluroxypyr, and Rimsulfuron (BLM 2016, Table 2-5) (Design Feature 6).

Similarly, incorporating best practices for pollinators on western rangelands (Xerces 2018) for mechanical treatments like mowing, and targeted grazing, prescribed fire, and chemical treatments, would reduce pollinator injury or death and habitat loss during treatments. Revegetation best practices (Xerces 2018) would help increase vegetation structural diversity and function, improving pollinator habitat conditions following treatments. In turn, this would facilitate movement toward desired conditions in treatment areas.

All restoration treatments in all vegetation states would move an area toward desired condition by increasing native plant diversity and structural complexity, improving plant vigor, and improving nutrient and hydrologic cycling. Having the flexibility to select the most effective methods for restoration of a site and being able to re-treat as necessary would reduce the risk of long-term increases in undesirable species. The flexibility of treatment methods under Alternative B provides the opportunity to speed up improvements to plant community function. Where treatments are implemented in vegetation states in lower elevation, relatively warm and dry sites, project inputs would be more intensive, potentially more expensive, and may require multiple treatments to succeed. Additionally, even if restoration in these sites is successful, the threat of pinyon-juniper and invasive annual grass expansion would remain, given the pressure from adjacent untreated plant communities that are outside of the desired condition. Over time, transforming vegetation states to ones dominated by native perennial species across the landscape having a mosaic of desired conditions would improve resistance and resilience. Indirectly, this would encourage natural burn patterns with fewer acres burned, and restored sites would connect patches of previously fragmented sagebrush communities.

Compared with Alternative A, increased treatment method flexibility under Alternative B would provide greater opportunity for successful treatments, as the BLM could select the most effective treatment method based on site conditions. This would maximize the potential for moving vegetation towards, or achieving, desired conditions.

Special Status Plants

The impacts on special status plants of achieving objectives in specific vegetation states would be similar to those described for general vegetation above. The treatment methods and potential acres available would also be the same (**Table 2-1**). The availability of all treatment methods, including those with widespread continuous application, surface disturbance, and/or heavy equipment, could cause potential damage to undetected special status plants and seed banks. Initial removal of aboveground biomass and other vegetation alterations would affect conditions for pollinators, which may decrease pollination opportunities and rates for special status plants.

In addition to design features described for general vegetation, surveying for special status plants (Design Feature 34) would reduce the likelihood of special status plant species being present in the treatment area; the potential for impacts from the use of treatment methods would be reduced. Any treatment that would likely adversely affect proposed or listed ESA plants and their designated critical habitat would require additional site-specific ESA Section 7 consultation.

Movement toward the overall desired condition, a mosaic of Perennial Grasses, Forbs, and Shrubs and Perennial Grasses and Forbs vegetation states, would increase the resistance and resilience of habitat. Over time, this might help to return natural burn patterns and fire return intervals in the project area, which would decrease the potential for special status species' habitat loss to wildfire and invasive species spread. Movement toward desired vegetation states would also increase plant community diversity and improve conditions for pollinators over the long term. Over time, these changes would improve pollination opportunities and promote the recovery or maintenance of special status plant species and habitats. In addition to treated areas, special status plants that occur in adjacent habitats would benefit from long-term habitat alterations because treatments would provide a buffer to disturbances such as nonnative plant invasions and wildfire spread.

4.2.5 Effects from Alternative C

The effects from Alternative C are similar to Alternative B but on a smaller scale with fewer treatment options. The potential treatment area for this alternative is 26.8 million acres with an emphasis area of 18.7 million acres (**Map 3**); both areas cover approximately 70 percent of the area of Alternative B (**Section 2.2.3**). Most projects are expected to occur within the emphasis area. Treatment methods would be limited to manual and mechanical methods (as described in Alternative B and **Section 4.2.2**, Nature and Type of Effects) along with a restriction of native plant material use for all revegetation. No sagebrush would be removed. Treatments relative to resistance and resilience of an area would follow Alternative B guidelines but with no treatments in highly resistant and resilient areas. Outside of highly resistant and resilient areas, treatments could occur in all vegetation states aside from Shrub with Depleted Understory and Pinyon-Juniper Phases II and III. Based on the associated risk of large or high severity fires along with invasive annual grass invasion, not treating these two vegetation states could pose an indirect risk to adjacent intact highly resistant and resilient areas. **Table 2-2** shows which treatments would be allowed in each of the vegetation states.

Considering chemical treatments are not an option in this alternative, treatments in vegetation states with an invasive annual grass component (**Table 3-2**) could promote an increase of invasive annuals. Manual methods for planting and seeding would have the least threat of disturbing the soil and, consequently, decreased opportunity for invasive annual grass increases. Treatments of intact plant communities adjacent to areas with invasive annual grasses would be approached with caution.

Restricting revegetation to native plant materials could increase the cover of native species in project areas, increasing plant community diversity, structure, and function. In some situations, however, native species may not compete well in vegetation states with invasive annual grasses (Miller et al. 2015) or nonnative perennial grasses. Revegetation with native plant materials in these areas without pre- and/or post-chemical treatments of invasive annual grasses and nonnative perennial grasses would likely result in the treatment area being reinvaded by these species or would require the use of more invasive mechanical methods such as tilling, increasing the necessity for multiple treatments and slowing movement towards desired conditions where treatments were done.

Vegetation states without invasive annual grasses as a component of the plant community and buffered from areas where invasive annual grasses occur would be optimal for manual or mechanical planting treatments. Augmentation with native plant material would provide the opportunity to increase the plant communities' resistance and resilience by increasing diversity, structure and function, vigor and overall health.

In all vegetation states, if revegetation is partially successful, especially projects incorporating best practices for pollinators on western rangelands (Xerces 2018), this would increase plant species diversity and increase food sources for pollinators and other animals. The risk of invasive grass spread, pinyon-juniper encroachment, and fuel loading would still be present but to a lesser extent. This risk would decrease as vegetation treatments become established, subsequently also offering greater protections to adjacent sagebrush communities.

Because highly resistant and resilient sites would be avoided, no direct effects on vegetation states in these areas would occur. Therefore, where present, the following site attributes would be preserved: natural sagebrush recovery from disturbance is likely to occur, perennial herbaceous species are sufficient for recovery, and the risk of invasive annual grasses is typically low (see Table 2 in Chambers et al. 2014b).

Though direct effects would not occur, vegetation states in highly resistant and resilient sites may be indirectly affected by treatments in nearby areas with low to moderate resistance and resilience. For example, successful treatments in adjacent low to moderate resistance and resilience communities would enhance connectivity and increase the resistance and resilience of these areas. This may provide a protective buffer around untreated highly resistance and resilient areas, reducing the potential that these sites would experience invasive annual grass conversion or pinyon-juniper encroachment. If historical fire regimes are reestablished near sites with high resistance and resilience, the potential that wildfire would burn a given site would likely decrease in the long term.

In all vegetation states where treatments would occur, implementing design features (**Appendix D**) would reduce the intensity of effects from restoration projects. Effects would be as described for Alternative B for those treatment methods allowed under Alternative C (i.e., manual and mechanical treatments). Similarly, incorporating best practices for pollinators on western rangelands (Xerces 2018) for mechanical treatments would have effects as described under Alternative B.

Compared with Alternative B, limitations on the types of treatment options available may limit restoration success in some cases and likely would decrease the number of acres available for restoration treatments. Restoration efforts in vegetation states with invasive annual grasses and nonnative perennial grasses would be potentially more expensive, and less likely to succeed. Increasing resistance and resilience of disturbed, degraded, or invaded areas would occur more slowly than if additional treatment options were available, such as chemical treatments, prescribed fire, or targeted grazing. Although areas of high resistance and resilience would not be treated, all treatments that occur within Alternative C would increase protection to adjacent areas by broadening sagebrush communities and connectivity, and enhancing resistance and resilience of vegetation communities.

Special Status Plants

The impacts on special status plants of specific treatment methods needed to move conditions toward a desired vegetation state would be similar to those described for general vegetation above. The treatment methods and potential acres available would also be the same (**Table 2-2**). Special status plant species that are associated with these vegetation states may experience direct and indirect impacts from implementation of manual and mechanical treatments as described under *Nature and Type of Effects*.

The potential for injury or mortality and the loss of habitat suitability of undetected special status plant species and seed banks would increase relative to Alternative A, but would be limited to effects from manual and mechanical tools. This is because the nature of treatments would generally be less invasive and smaller in scale given the limitations on treatment methods and locations. Design features, as described under Alternative B, would further limit impacts on special status plant species associated with implementing treatments. Limitations to surface disturbance from the use of only manual and mechanical methods would reduce the risk of invasive annual grass invasions into special status species habitat. However, the limited availability of tools for treatments might slow the establishment of desired vegetation states and habitat conditions. More follow-up treatments could be required to achieve desired states, leading to more localized impacts over the long term.

Where treatments are successful, movement toward desired vegetation states would alter special status plant habitat by increasing resistance and resilience. Over time, this would improve habitat conditions for special status plants due to increased community diversity and improved conditions for pollinators through shrub and grass planting. Decreased availability of fine fuels could reduce the potential for habitat loss from disturbances.

However, because treatments would be unlikely to occur in invaded areas with relatively low resistance and resilience, restoration of these areas would be limited, and they would continue to provide low-quality habitat for special status plants. Areas remaining as low resistance and resilience sites would threaten special status populations and habitat in adjacent areas with higher resistance and resilience due to the threat of wildfire and invasive grass invasions. For areas that are successfully treated and moved toward the overall desired condition, special status plants that occur in nearby habitats would benefit from long-term habitat alterations because treatments would provide a buffer to disturbance.

4.2.6 Effects from Alternative D

Alternative D would have the same treatment methods (**Table 2-1**) and flexibility described in Alternative B apart from excluding treatments in the Pinyon-Juniper Phase III vegetation state and a more limited geographic area. For this alternative, the emphasis area and potential treatment area are the same: 5.6 million acres within the FIAT Planned Treatment Areas (**Section 2.2.3**; **Map 4**).

The limited potential treatment area of Alternative D would provide a higher concentration of restoration projects. This would create a higher density of restoration projects, improving connectivity of existing and restored sagebrush communities in a smaller area. Improvements would provide a more heterogeneous landscape depicting mosaics within sagebrush communities that provide a more natural fire return interval and a decreased threat of invasive annual grass spread in a more condensed area. As enhancements of sagebrush communities in the potential treatment area take hold, the benefits of the decreased threat of fire and spread of invasive species would be expanded to adjacent areas. However, degraded sagebrush communities adjacent to the potential treatment area under Alternative D would not be treated and the imposing risks associated with degraded sites, including invasive species expansion and shortened fire return intervals, would continue to threaten the FIAT planned treatment areas.

Overall, and over the long term, restoration projects under Alternative D would have the flexibility of treatment options to provide a greater opportunity to protect, conserve, and restore sagebrush communities than those under Alternative A, thus improving the magnitude of project efficacy. Increased treatment method flexibility would provide greater opportunity for successful treatments, as the BLM could select the most effective treatment method given site conditions. This would maximize the potential for moving vegetation towards, or achieving, desired conditions.

Like Alternative C, the extent of these effects would depend in part on the scope of existing local NEPA analysis for fuels reduction and rangeland restoration projects. Allowing all potential treatment methods would provide the maximum potential for movement toward desired conditions in all vegetation states; however, by not treating the relatively large areas outside FIAT planned treatment areas, the high-quality vegetation in the planned treatment areas may be at a greater threat of loss or conversions over time due to wildfires in adjacent untreated areas.

Special Status Plants

The impacts on special status plants of specific treatment methods needed to move conditions toward a desired vegetation state would be similar to those described for general vegetation above. The treatment methods would also be the same (**Table 2-3**). Special status plant species that are associated with these vegetation states may experience direct and indirect impacts from implementation of all treatment methods. Design features, as described under Alternative B, would limit impacts on special status plant species associated with implementing treatments.

Focusing treatments in FIAT planned treatment areas would concentrate restoration projects to areas considered to provide high-quality habitat. Areas treated would generally be highly resistant and resilient sites at higher elevation and precipitation levels compared with surrounding areas. Movement toward desired vegetation states would alter habitat conditions for special status plants and pollinators by improving plant community structure and function, and increasing vegetation resistance to invasion and resilience from disturbance such as wildfire. Habitat alterations would be limited to FIAT planned treatment areas; surrounding areas, including large, degraded areas with low resistance and resilience, would remain in these states and continue to provide low-quality habitat for special status plants and pollinators. High-quality habitat for special status plants and pollinators in FIAT planned treatment areas may be at a greater threat of loss or alterations over time due to disturbances in adjacent untreated areas.

4.2.7 Cumulative Effects

Past, present, and reasonably foreseeable future human actions, combined with such natural processes as wildfire, that have affected vegetation in the cumulative effects analysis area are wildfires and fuel loading, wildfire suppression, noxious and invasive weed spread, fuel breaks and other vegetation management projects, livestock grazing, roads, ROWs, mining and fluid mineral development, and land use planning, as summarized in **Table 4-1**. **Table 4-1** summarizes the amount of the cumulative effects analysis area that has been, and will likely be, affected by human actions and natural processes. Effects from these human actions and natural processes are briefly discussed below.

The size and frequency of natural and human-caused wildfires have increased throughout the project area in recent years, resulting in widespread impacts on vegetation in sagebrush communities. Depending on the severity, wildfire has altered vegetation by reducing sagebrush cover and facilitating invasive species spread. Increased fuel loading and continuity from both pinyon-juniper encroachment and invasive annual grass spread into sagebrush communities have contributed to increased wildfire frequency and severity (Rowland et al. 2008; Davies et al. 2011a).

Wildfire management and ESR treatments have affected vegetation in the project area in multiple ways. In some areas, past wildfire suppression has increased fuel loading and associated severe wildfire risk in sagebrush communities by allowing woody fuels, including pinyon-juniper woodlands, to accumulate (Miller et al. 2005; Hanna and Fulgham 2015). Additional suppression-related effects on vegetation are removal during fire line construction, and the associated increased potential for invasive annual grass establishment in areas disturbed during fire suppression activities. Some areas benefit from the protection of sagebrush communities during wildfire suppression. Though wildfire suppression is still carried out on public lands in the project area, wildfire is recognized as a natural ecosystem process necessary for ecosystem health in certain areas, such as highly resilient sites (USGS 2002). As described in **Table 4-1**, the NIFC will continue to coordinate with multiple agencies and jurisdictions to develop and implement wildfire policy, which would likely reduce the intensity of effects on vegetation over time. Moreover, fire managers are expected to continue to develop, update, and implement fire management plans in response to changing technology and environmental conditions, having similar effects on vegetation.

Noxious weeds and invasive plant species have invaded many locations in the project area, carried by wind, water, humans, machinery, and animals. Invasive annual grasses displace native vegetation and increase fuel loading and continuity in sagebrush communities, and thus increase wildfire spread. Increased cover of invasive annual grasses has also initiated annual grass invasion/wildfire cycles characterized by shortened fire return intervals and larger, more contiguous fires (D'Antonio and Vitousek 1992; Brooks et al. 2004). As described in Chapter 3, an estimated 17 million acres in the

Great Basin are currently dominated by the invasive annual grass cheatgrass and it has established itself as a component of the broader plant community in an additional 62 million acres (Diamond et al. 2012 in Ielmini et al. 2015).

The spread of noxious weed and invasive plant species is managed under federal-, state-, and local-level plans, as described in **Table 4-1**. In the absence of restoration or abatement activities, noxious and invasive weed species are expected to continue spreading on all lands in the project area, increasing the risk of wildfire. Future management for invasive annual grasses and noxious weeds would help mitigate impacts, and management may change in response to new and improved technology, changed environmental conditions, or new policies on the spread of noxious weeds and invasive plants.

The BLM, other federal agencies, local and regional partnerships, and other groups have created and maintained fuel breaks in the project area as described in **Table 4-1**. Projects range in size from 7 miles (Midway Fuel Break Project) to over 400 miles of fuel breaks (Soda Fuel Break Project). The area affected by these projects would continue to expand as new fuel breaks are created as part of approved projects, and as part of the BLM's reasonably foreseeable PEIS for Fuel Breaks in the Great Basin, over the next several years. In general, fuel breaks alter vegetation structure by reducing fuel loading and continuity in the breaks, which increases opportunities for firefighter response, helping to reduce wildfire severity and intensity, and minimizing alterations to plant communities. In some cases, fuel breaks have contributed to the spread of invasive weeds (Shinneman et al. 2018). Existing and future fuel breaks would support the retention of investments made for fuels reduction and rangeland restoration projects by helping to limit fire spread, which would reduce the risk of loss of sagebrush communities from wildfire and the spread of invasive species. Creating and maintaining a system of fuel breaks under the BLM's reasonably foreseeable PEIS for Fuel Breaks in the Great Basin would protect vegetation that has been rehabilitated in the past and that would be restored under the Proposed Action analyzed in this Fuels Reduction and Rangeland Restoration PEIS.

Other types of vegetation management and ESR projects (**Table 4-1**) have affected vegetation in the project area. Hazardous fuels reduction, pinyon-juniper removal, seedings, shrub planting, and invasive plant control projects have affected vegetation cover and structure, reduced noxious weed and invasive plant prevalence, and altered fire frequency. In turn, these projects have reduced wildfire risk, and thereby reduced the potential for impacts from high-intensity wildfires. These projects have ranged in size as well, covering as little as 500 acres (West Carson Fuels Project) to over 4 million acres (Sawtooth and Boise National Forests Invasive Species Project). In some cases, new projects may overlap the locations of past projects, especially where success was previously limited or new threats have established.

Site-specific projects that may be authorized based on this PEIS would not likely overlap the treatments included in proposed or in-progress projects unless methods included in this PEIS could augment project design and aid in achieving goals and objectives. In cases where proposed or ongoing projects meet the objectives for those project areas, the treatment level and/or scale of this PEIS would be reduced. For example, the Bruneau Owyhee Sage-grouse Habitat Project is underway and will treat up to 617,000 acres in the early stages of juniper encroachment in southwestern Idaho to maintain and improve sagebrush communities (BLM 2018c). If project objectives are met, then a large portion of the potential treatment area would not require treatments under this PEIS. See **Table 4-1** for other examples of past and ongoing vegetation management projects in the project area.

Ongoing permitted livestock grazing and trailing occurs throughout most of the project area and is expected to continue. This effect is widespread in the project area; less than 1 percent of sagebrush communities in the Great Basin remain untouched by livestock grazing (Paige and Ritter 1999). Historical grazing pressure has modified sagebrush communities in the project area by influencing plant community condition and structure and affecting wildfire fuel loading (Strand et al. 2014). To address this, the BLM manages livestock grazing in accordance with established policy that has been approved by the Secretary of the Interior (43 CFR 4120–4130), with the overall objective of preserving and restoring rangeland conditions.

Multiple kinds of past and present development and planning have affected vegetation in the project area (**Table 4-1**). These are roads and other ROWs, such as transmission lines, pipelines, and renewable energy developments, and minerals exploration and development. Typically, impacts on vegetation are localized, when surface-disturbing activities like site grading remove vegetation. Indirectly, developments have also affected vegetation community condition by facilitating noxious weed and invasive plant spread. In some cases, development can indirectly affect vegetation on a larger scale. For instance, roadside wildfire ignitions can cause effects where fuel loading, continuity, and weather conditions facilitate severe wildfire spread.

Authorized developments are generally subject to minimization measures as part of the land use planning process, which have reduced impact intensity and extent. Reasonably foreseeable continued population and recreation growth will increase demand for, and construction of, these types of development. Vegetation degraded from development could be improved using past, present, and future vegetation management plans, including this Proposed Action, to restore sagebrush communities and fire return intervals.

Without intervention, the past, present, and reasonably foreseeable human actions and natural processes described above would continue to affect the vegetation condition. Fuels reduction and rangeland restoration projects would continue to be implemented throughout the project area on a site-specific basis, but the rate at which future projects are implemented would be reduced by the lack of a programmatic framework. As a result, vegetation resistance to invasion and resilience from disturbance would be restored or enhanced, and fuels continuity would be disrupted at the current rate and potentially in fewer areas. Vegetation would continue to be vulnerable to effects from wildfire. These effects would likely be worsened by expected trends of continuing noxious weed and invasive plant species spread.

Cumulative effects common to all action alternatives would come about from carrying out restoration projects to modify wildfire behavior by reducing available fuels during fire season, lengthen fire return intervals, and restore natural burn patterns. This would cumulatively affect vegetation by restoring degraded plant communities and enhancing vulnerable plant communities to improve plant community resistance to invasion and resilience from disturbance, including wildfire. These effects would be additive to similar effects from other fuels reduction and rangeland restoration projects (**Table 4-1**) authorized and carried out separately from this planning effort. The relative contribution to cumulative impacts from each action alternative would differ, based on the treatment areas and methods proposed under each action alternative; these differences are discussed below.

Cumulative effects common to all action alternatives would also come about from implementing design features (**Appendix D**) during project planning and implementation, and by designating treatment exclusion areas (**Section 2.2.1**). In general, implementing design features would minimize the cumulative adverse impacts on vegetation from treatments. Design features would minimize desired vegetation removal by, for example, using previously disturbed areas for mobilization, and they would minimize the potential for noxious weed and invasive plant species spread by conducting weed management.

Alternatives B and D would place the fewest limitations on the locations, treatments, and revegetation methods that could be used to implement rangeland restoration projects. More vegetation would likely be affected in more areas, and by more treatment methods, compared with Alternative A. Alternatives B and D would have the greatest potential to improve disturbed, degraded, or invaded areas, and to place treatments adjacent to intact sagebrush communities. With this, treatment efficacy and the rate at which treated areas move toward desired conditions would likely be increased. Incorporating the same design features (**Appendix D**) described above, as well as features to minimize detrimental impacts from targeted grazing (Design Features 15–17) and prescribed fire (Design Features 9–14), would minimize the cumulative impacts. As a result, Alternatives B and D would likely be more effective at improving sagebrush community resistance and resilience by reducing available fuels during fire season, restoring natural burn patterns, lengthening fire return intervals, and decreasing threats from invasive plant expansion.

The larger potential treatment area under Alternative B, in comparison with Alternative D, would also provide greater opportunity for successful treatments, by virtue of additional flexibility in appropriate project placement. By not treating the relatively large areas outside of FIAT planned treatment areas in Alternative D, the high-quality vegetation in these areas may be at greater threat of loss or conversion over time due to wildfires in adjacent untreated areas. Overall, these alternatives would likely be the most effective at reducing the amount of sagebrush communities burned in the long term.

Alternative C proposes the most limited range of treatments and would result in the fewest effects within the project area; however, like Alternative A, there would still be opportunities to perform site-specific NEPA that could supplement actions taken under Alternative C. Achieving treatment objectives would likely take longer than other action alternatives because the full suite of treatment and revegetation options could not be used. The limitations of Alternative C would hinder the application and success of treatments, especially in disturbed, degraded, or invaded areas. This would lead to more sagebrush communities being degraded from invasive species spread, more pinyon-juniper encroachment, and a subsequent increased risk of fire, ESR, and disturbance from fire suppression activities. Thus, treatments under Alternative C would likely modify wildfire behavior and restore sagebrush communities to a lesser degree than other action alternatives.

Special Status Plants

The cumulative analysis area for special status species and baseline effects of past, present, and reasonably foreseeable future actions on special status plant species are the same as those described for general vegetation above.

When combined with the baseline effects of natural and human-caused wildfires, vegetation treatments, and human development, all alternatives would increase the potential for injury or mortality of undetected special status plant species. This is because treatments would cause vegetation removal or trampling, soil surface disturbance, and mortality. This effect would be greatest under Alternative B, which proposes the greatest acres of habitat types available for potential treatments and the greatest flexibility in the use of tools thus opportunity to apply the most effective treatment. Alternatives C and D would contribute less to the increased risk of injury or mortality. This is because a smaller area would be open to potential treatments relative to Alternative B, and in the case of Alternative C, only manual and mechanical treatment methods would be used. Under all alternatives, the implementation of avoidance measures through design features would substantially reduce or eliminate the contribution to the increased risk of injury or mortality.

Other types of vegetation management projects (**Table 4-1**) have been or are being implemented throughout the project area. The combined effects of such projects would increase the potential for injury or mortality of undetected special status plant species over a large area (see estimated acres in **Table 4-1**). However, where these projects are successful in meeting goals and objectives, the treatment level and scale of this PEIS would be reduced and the contribution of effects from this PEIS to the cumulative effect would be smaller. Other projects would also contribute to habitat alterations over the areas shown in **Table 4-1**.

When combined with the baseline effects of human and natural activities that reduce or modify special status species plant habitat, treatments would lead to a countervailing effect over the long term. When further combined with habitat alterations from vegetation and habitat protections from the BLM's PEIS for Fuel Breaks in the Great Basin, treatments would add to habitat improvements by increasing habitat resistance to invasive species and resilience to disturbances, which would facilitate species recovery.

Alternative B would have the greatest contribution to long-term habitat alterations. This is because this alternative would have the greatest treatment method flexibility, so it would provide greater opportunity for successful treatments. This is because the BLM could select the most effective treatment method given vegetation state conditions in the project area and other site-specific considerations. Indirectly, this would maximize the potential for moving vegetation towards, or achieving, desired conditions. Alternative C would modify habitat at a slower pace because treatment methods would be limited to manual and mechanical treatment methods. The extent of the area subject to habitat modifications would also be reduced under Alternative C because sagebrush would not be treated, no treatments would occur in the **Pinyon-Juniper Phase II** or **Phase III** vegetation states, and no treatments would occur in highly resistant and resilient sites. The contribution of Alternative D to habitat modifications would be limited to FIAT planned treatment areas; high-quality habitat for special status plants and pollinators in these areas may be at a greater threat of loss or alterations over time due to wildfires in adjacent untreated areas.

4.3 Fire and Fuels

4.3.1 Assumptions

The assumptions for analyzing the impact on fire and fuels are as follows:

- Vegetation is the fuel for wildland fire. The extent and type of vegetation states (see **Table 3-3**) directly affect the pattern and frequency of wildfires over time (also see **Section 4.2**, Vegetation).
- The amount of fine (annual grass) fuel loading, sagebrush density, heavy (Phase II and III Pinyon-Juniper vegetation states) fuel loading, and continuity of these fuel types in sagebrush communities are the primary factors that contribute to departure from desired sagebrush vegetation conditions (Miller et al. 2013). These factors, in turn, influence departure from fire regimes.

- Altered fire regimes transform ecosystems, such as through the conversion of heterogeneous sagebrush and perennial grass ecosystems to homogeneous annual grass-dominated communities following fire, which further perpetuates vegetation departure and fire regime alterations.
- Treatments would move vegetation towards the desired conditions in the long term, resulting in improved plant community function and fewer acres burned. Achieving the desired conditions may require multiple treatments (see **Section 4.2**, Vegetation).
- Invasive plant species are expected to continue to spread, and treatments may reduce the rate of spread but is unlikely to eradicate these species.
- Until treatments have been implemented and the desired conditions achieved, fires would burn with the same intensity and severity as current trends.

4.3.2 Nature and Type of Effects

Effects Common to All Vegetation States

Restoration treatments that reduce the amount of fuel loading would limit the ability of wildfire to advance through vegetation communities. This is because a lack of fine or heavy fuels would influence burn patterns and spread, thereby reducing the amount of acres burned. In general, reducing and replacing invasive annual grasses with perennial species, varying sagebrush densities, and reducing pinyon-juniper encroachment would limit the ability of those treated areas to carry fire across the landscape and convert to invasive annual grass vegetation states following fire. Treatments would also reduce the potential of early-season fires encountering cured fuels. This is because invasive annual grasses cure earlier in the season.

Treatments would break up fuel continuity and create more heterogeneous vegetation communities. The result would be that some treated and adjacent untreated areas could burn, while others would not. This would create a patchwork, or mosaic burn pattern that would more closely resemble historic fire regimes (Duncan et al. 2015) within and immediately surrounding the treatment area. Unburned areas would maintain available seed sources to regenerate burned areas. In treated areas, subsequent recolonization by invasive annual grasses following noncontiguous fires would be less likely (Chambers et al. 2017 p. 103). Perennial grass and forb and sagebrush communities with more age class diversity would support a long-term transition to the desired fire regimes typical in the project area. Treatments ultimately would improve vegetative health and resistance and resilience, as the resulting mosaic vegetation conditions would be less susceptible to dominance by invasive annual grasses (Chambers et al. 2017, p. 103) and future disturbances, including fire.

Short- and long-term vegetation condition departures following treatments would directly influence wildfire seasonality and burn patterns. Treatments that reduce fine fuel and heavy fuel loading in native and nonnative perennial grass and forb vegetation states and sagebrush communities will have varying outcomes on resistance and resilience depending on the type, location, and nature of the treatment. In general, treatments in low, moderate, and high resistance and resilience sites would improve resistance to incremental increases in annual grass cover. Multiple treatments would likely be required in low resistance and resilience sites to achieve desired conditions, whereas fewer treatments would be needed in moderate and high resistance and resilience sites. Although treatment could result in the potential for disturbance and conversion of disturbed areas to invasive annual grass-dominated communities, soil moisture and temperature regimes of highly resistant and resilient sites render these areas more productive and less hospitable to invasive annual grasses than drier, warmer sites (Chambers et al. 2014). High underlying resistance and resilience, combined with treatments, would limit the potential for short- or long-term vegetation condition departure and changes to wildfire seasonality and burn patterns in highly resistant and resilient areas. Short-term vegetation condition departure could persist in low and moderate resistance and resilience areas until treatments are successful. Restricting treatments in highly resistant and resilient sites would avoid disturbance but could result in an incremental increase in shrubs or invasive annual grass cover over time, which could result in altered fire regimes in some highly resistant and resilient areas over the long term.

In all vegetation states, reseeding with native seeds would support the long-term transition of those communities to desired vegetation conditions, which would support a return to historic fire regimes. Appropriately selected native species are adapted to the microclimatic and topographic characteristics of the treatment site (Duncan et al. 2015). A community containing these species would likely exhibit enhanced resistance to invasive annual grass invasion and resilience following disturbance like fire (see **Section 4.2**, Vegetation). Over the long term, restoring native grasses, forbs, and sagebrush communities would reduce departure from desired conditions of fire regimes.

Effects in Vegetation States with Invasive Annual Grasses

Fuels reduction and rangeland restoration treatments in vegetation states with an invasive annual grass component (see **Table 3-2**) would reduce invasive annual grasses within that vegetation state and return those areas to desired vegetation states with perennial grasses, forbs, and shrubs. These treatments would incrementally slow or reverse the trend of altered fire regimes compared with current conditions. As invasive annual grass vegetation states shift toward the desired conditions following treatments, the extent of vegetation departure in treated areas would decline, further promoting a return to a historic fire regime in the long term once desired vegetation conditions are achieved.

Effects in Vegetation States with Shrubs

Treatments in vegetation states with shrubs (see **Table 3-2**) would move toward desired conditions consisting of a mosaic of uneven-aged shrubs with an understory of perennial grasses and forbs. Diversity in the vegetation structure would result in wildfires burning in mosaic patterns with varying intensities based on the underlying fuels. Wildfires burning through a mosaic pattern of dense (older) and less dense (younger) sagebrush communities with an understory of perennial grasses and forbs would burn in a patchwork pattern, reducing the number of acres burned. Patches of unburned vegetation would provide a seed bank allowing native vegetation to recolonize after wildfire. This mosaic of burned and unburned vegetation would also be more resistant to annual grass colonization than an area with no remaining vegetation following wildfire. Over the long term, there would be longer fire return intervals and time for sagebrush and understory grasses and forbs to reestablish after wildfire, which would result in more vegetation states with shrubs having desired historic fire regimes.

Effects in Vegetation States with Pinyon-Juniper

In the short term, treatments in Phase I Pinyon-Juniper areas would reduce the potential for isolated or group tree torching that could contribute to fire spotting in other receptive vegetation states. In the long term, a restored understory would be more resilient to fire and resistant to conversion to invasive annual grasses and new encroachment of pinyon-juniper; this would contribute to patchier burn patterns, which would limit fire spread into adjacent vegetation communities.

Treatments in Phase II and Phase III Pinyon-Juniper vegetation states would reduce ladder fuels and dense pinyon-juniper stands that contribute to intense crown fires. Treatments would also break up the overstory, limiting the potential for the movement of wildfire to adjacent vegetation communities.

Treatments in all pinyon-juniper vegetation states would restore the structure and function of sagebrush communities by improving the viability of perennial grass, forb, and sagebrush understories. Diversity in the vegetation structure would result in wildfires burning in mosaic patterns with varying intensities based on the underlying fuels. Over the long term, these factors would contribute to the shifting of fire regimes toward historic conditions.

4.3.3 Effects from Alternative A

Under Alternative A, there would continue to be site-specific treatments that would reduce fuel loading and improve resistance and resilience within the treated areas However, the spread of invasive annual grasses would continue in many areas. Over time, this would expand the portion of the project area with invasive annual grass cover. In vegetation states with invasive annual grasses there would be fine fuels available earlier in the fire season and later into the fall. Fire ignitions in vegetation states with invasive annual grasses would likely result in wildfires burning into surrounding perennial grass and forb and sagebrush communities, including highly resistant and resilient sites. Over time, this would shift those areas toward less desirable invasive annual grass-dominated vegetation states with associated departure from fire regimes.

Perennial Grasses and Forbs and Perennial Grasses, Forbs, and Shrubs vegetation states, would experience desired fire regimes, especially in the near term. However, increasing fire frequency and the incremental spread of invasive annual grasses from adjoining vegetation states with invasive annual grasses would steadily transition the intact Perennial Grasses and Forbs and Perennial Grasses, Forbs, and Shrubs communities to vegetation states with an invasive annual grass component. These areas would become more susceptible to uniform burn patterns, further seed source for expanding annual grass-dominated communities, and highly altered fire regimes over the long term. Similarly, areas of Shrub with Depleted Understory would be susceptible to uniform burn patterns, subsequent conversion to annual grass-dominated communities, and highly altered fire regimes over the long term.

Pinyon-juniper encroachment into sagebrush communities would continue, which would allow wildfire to carry at high intensities into other vegetation communities. Contiguous areas of burned pinyon-juniper would likely convert to invasive annual grass-dominated vegetation states (Chambers et al. 2015), especially in the absence of emergency stabilization and rehabilitation treatments. Post-fire, these monocultures of invasive annual grasses would experience frequent fires that would burn uniformly across the landscape. This would perpetuate the cycle of fire followed by invasive annual grass recolonization and an increasingly shorter fire return interval.

4.3.4 Effects Common to All Action Alternatives

Compared with the no action alternative, a regional programmatic NEPA analysis under the action alternatives (Alternatives B, C, and D) would allow local offices to more efficiently implement fuels reduction and rangeland restoration treatments and shift vegetation communities toward the desired conditions.

Under all action alternatives, there would be the potential that initial treatments may not meet objectives and follow up treatments would be needed. The short-term effects would be that those impacts described under Alternative A would continue but would incrementally decrease until treatment objectives are achieved.

Over the long term, the action alternatives would achieve the desired conditions in **Section 2.2.9**, with impacts in the respective vegetation states as described in *Nature and Type of Effects*. However, the locations of treatments and the tools available would contribute to different impacts on fire and fuels under each action alternative, as described below.

4.3.5 Effects from Alternative B

Effects in Vegetation States with Invasive Annual Grasses

Under Alternative B, using treatment methods outlined in **Table 2-1** in Invasive Annual Grasses and Perennial Grasses, Forbs, and Invasive Annual Grasses vegetation states, would directly affect fire and fuels by reducing fuels loading and continuity by shifting vegetation states with invasive annual grasses to more desired species composition and structure (see **Section 2.2.9**). As described in *Nature and Type of Effects*, because the treatments would decrease invasive annual grass cover and increase perennial grass and forb and shrub plant cover, fire return intervals would be longer and early-season curing of fuels would be less likely compared with Alternative A.

In the Nonnative Perennial Grasses and Forbs vegetation state, treatments of invasive annual grasses and nonnatives would increase structural diversity through the removal of continuous fuels and the introduction of native perennial forbs, grasses, and shrubs as desired. In the Native Perennial Grasses and Forbs vegetation state, this would be done through the introduction of shrubs where desired. The mosaic vegetation pattern created by these treatments would alter the movement of fire so that burn patterns would be less contiguous, compared with Alternative A.

Treatments in vegetation states with invasive annual grasses would support desired vegetation conditions and associated fire regimes in each vegetation state, minimizing the potential for further departure from historic conditions. Treating these areas would result in localized surface disturbance, especially when using mechanical and prescribed fire methods, which could impact fire and fuels if invasive annual grasses establish following disturbance. However, treatments to maintain and enhance desired conditions would offset short- and long-term impacts from localized disturbance. Successfully restored areas would be less susceptible to contiguous burn patterns and shortened fire return intervals. Early-season fires would also be less likely to encounter homogenous cured fuels that propagate fire uniformly across the landscape.

Using chemical, prescribed fire, and targeted grazing treatments and perennial grass and forb seeds in vegetation states with invasive annual grass would optimize the short-term success of treatments and accelerate the achievement of desired vegetation conditions. This would increase treatment success and would have an incremental shift toward historic fire regimes. Compared with Alternative A, treatments under Alternative B would move vegetation towards desired conditions, lengthen the fire return interval, reduce acres burned, and avoid perpetuating the cycle of fires following invasive annual grass colonization in those areas.

Effects in Vegetation States with Shrubs

Treatment methods outlined in **Table 2-1** in the Invasive Annual Grasses and Shrubs and Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses vegetation states would remove and incrementally replace invasive annual grasses with perennial grass and forb species and varying shrub densities. In these vegetation states with shrubs, treatments would reduce the ability of vegetation to carry fire across the landscape and convert these areas to invasive annual grass-dominated communities following fire. Patchwork burn patterns would increase species and age-class diversity, which would further move fire regimes toward desired conditions over the long term. Minimal treatments in the Perennial Grasses, Forbs, and Shrubs vegetation state would largely preserve existing fuel conditions and associated fire regimes in those areas.

In the Shrub with Depleted Understory vegetation state, the nature and types of impacts on fire and fuels from implementing shrub cover reduction and revegetation treatments would be as described in *Nature and Type of Effects*.

The use of multiple treatment methods would optimize and accelerate the achievement of desired vegetation conditions, which would more immediately shift vegetation structure and function toward historic conditions. Achieving the desired Perennial Grasses, Forbs, and Shrubs vegetation state on a larger portion of the project area compared with Alternative A would result in more areas where the fire return interval, mosaic burn pattern, and fewer acres burned resemble fire regimes and fewer areas where fuels are likely to perpetuate the cycle of invasive annual grass colonization following fires.

Effects in Vegetation States with Pinyon-Juniper

Compared with Alternative A, reducing pinyon-juniper encroachment, dense pinyon-juniper cover, and restoring understory vegetation in all pinyon-juniper phases would lessen or reverse the trend of encroachment which alters fire regimes. In the short term, reducing biomass and pinyon-juniper tree cover would influence burn patterns and reduce fire intensity by reducing the potential for isolated and group tree torching and crown fires that would contribute to fire spotting in other receptive vegetation states. In the long term, a restored understory would be more resilient to fire and resist subsequent conversion to annual grasses and new encroachment of pinyon-juniper. Treatments would also allow for sagebrush communities to recover after fire while reducing pinyon-juniper encroachment.

Retaining stringers or clusters of pinyon-juniper trees to support habitat objectives could provide a localized heavy fuel source for fire and may lead to tree torching and crown fires, which may contribute to fire spotting in nearby receptive vegetation states, but adjacent vegetation restoration treatments would limit fire spread in these areas.

4.3.6 Effects from Alternative C

Effects in Vegetation States with Invasive Annual Grasses

Using treatment methods outlined in **Table 2-2**, reseeding areas with native species in Invasive Annual Grasses and Perennial Grasses, Forbs, and Invasive Annual Grasses vegetation states would affect fire regimes by shifting vegetation to a more desired species composition and structure. In the Nonnative Perennial Grasses and Forbs vegetation state, treatments of invasive annual grasses and nonnatives would increase structural diversity through the removal of continuous fuels and the introduction of native perennial forbs and grasses as desired. As described in *Nature and Type of Effects*, treatments would decrease invasive annual grass cover and increase the amount of perennial grass, forb, and shrub cover. This would contribute to longer fire return intervals and reduce available fuels, resulting in fewer acres burned by wildfire compared with Alternative A. Changes in burn patterns following treatments would also be as described in *Nature and Type of Effects*, and similar to Alternative B, except using only manual and mechanical treatments would limit the number of acres of invasive annual grasses or nonnative grasses that could be treated annually. Further, limiting treatments to manual and mechanical methods would limit the number of tools available to achieve desired conditions in the short term. In addition to perennial grass and forb seeding or planting, sagebrush planting in Alternative C would increase shrub density cover in areas lacking shrubs, such as in the Native Perennial Grasses and Forbs vegetation state, and would transition vegetation states toward a mix of desired perennial grasses and forbs with shrub component vegetation states (see **Sections 2.2.9** and **4.2**, Vegetation), with associated changes to desired fire regimes. Requiring native seeds for reseeding treatments could limit the viability and effectiveness of treatments in restoring desired perennial grass and forb communities in vegetation states with invasive annual grass (Ott et al. 2016; Hulet et al. 2010; Monsen et al. 2004; Kilcher and Looman 1983). Additional treatments could be necessary to ensure success. Until seedings are successful, treated areas would be vulnerable to invasive annual grass colonization or recolonization, with the associated impacts on fire and fuels described in *Nature and Type of Effects*.

Effects in Vegetation States with Shrubs

Implementing treatment methods outlined in **Table 2-2** in the Invasive Annual Grasses and Shrubs and Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses vegetation states would reduce fine fuels available for wildfires. Reseeding treatments in areas lacking shrubs would increase shrub density and cover, thereby creating more mosaic conditions in vegetation states with a shrub component that would have greater age, cover, and species diversity. It also would include more perennial grass and forb cover between shrubs (see **Section 4.2**, Vegetation). As described in *Nature and Type of Effects* and *Effects in Vegetation States with Invasive Annual Grasses*, the treatments would create mosaic vegetation conditions, which would modify burn patterns in the short and long terms. Patchwork burn patterns would create uneven age class sagebrush communities with longer fire return intervals and fewer acres burned, more closely resembling historic fire regimes.

Impacts on fire and fuels from not thinning sagebrush would lead to stands continuing to depart from desired conditions, becoming denser across a larger portion of the project area, creating a continuous fuel bed that could burn more acres with higher intensity and severity, and potentially burn into adjacent desired vegetation conditions. Requiring the use of native plant material would be the same as described in *Effects in Vegetation States with Invasive Annual Grasses*, above. There would be an associated shift in fire regimes away from desired conditions where increases in shrubs limit perennial grass and forb establishment or where there are corresponding increases in invasive annual grasses. Where treatments in surrounding vegetation states with invasive annual grasses have not occurred or were unsuccessful, invasive annuals may expand into intact communities.

Effects in Vegetation States with Pinyon-Juniper

As described in *Nature and Type of Effects*, removing pinyon-juniper and restoring or augmenting understory vegetation in areas identified as Phase I Pinyon-Juniper vegetation states would slow or reverse the trend of encroachment and altered fire regimes in the project area. However, restricting treatments to Phase I areas would limit the overall scope and effectiveness of treatments at achieving desired conditions for fire and fuels.

Limiting pinyon-juniper and understory treatments to manual and mechanical methods in Phase I areas reduces the number of acres treated annually and limits the number of tools available to achieve desired conditions in the short term. Shifting vegetation departure and associated fire regimes toward historic conditions may require multiple follow up treatments. The result would be that untreated acres and treated areas where invasive annual grasses remain the dominant species would be capable of carrying fire uniformly across the landscape, with little near-term success in reversing the overall fire regime trends in the project area.

Impacts on fire and fuels from not treating pinyon-juniper in Phase II and Phase III would be as described in Alternative A. Requiring native seeds would be the same as described above for *Effects in Vegetation States with Invasive Annual Grasses* and *Effects in Vegetation States with Shrubs*.

4.3.7 Effects from Alternative D

Effects in Vegetation States with Invasive Annual Grasses

Treatments in areas of Invasive Annual Grasses and Perennial Grasses, Forbs, and Invasive Annual Grasses vegetation states would lead to similar effects as Alternative B but would occur in a 5.6-million-acre potential treatment area instead of 38.5 million acres. Treatments in Nonnative Perennial Grasses and Forbs and Native Perennial Grasses and Forbs vegetation states would also occur in the 5.6 million acres.

Compared with Alternative A, treatments would result in fewer acres of combustible invasive annual grasses and would contribute to more historic vegetation conditions and less departure from fire regimes, specifically through more discontinuous burn patterns, fewer acres burned, longer fire return intervals, and reduced likelihood that early-season fires would encounter cured fuels. Like Alternative B, the BLM would have the greatest range of treatment options under Alternative D, which would maximize the likelihood of treatment success. As described in *Nature and Type of Effects*, this would increase the near-term potential for treatments to shift fire regimes toward more desirable conditions. Outside of the treated areas, effects on fire and fuels would be the same as Alternative A.

Effects in Vegetation States with Shrubs

Impacts on fire and fuels in the Invasive Annual Grasses and Shrubs and Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses, and Shrub with Depleted Understory vegetation states would be similar to Alternative B, but treatments would occur within a 5.6-million-acre potential treatment area instead of within 38.5 million acres.

Compared with Alternative A, the use of manual, mechanical, chemical, prescribed fire, mowing, and targeted grazing treatments would optimize the near-term potential for treatments to be successful, which would shift fire regimes toward more desired conditions in the short term. The overall long-term result of these treatments under Alternative D would be a transition toward more noncontiguous burn patterns, fewer acres burned, less frequent fire intervals, and reduced likelihood that early-season fires would encounter cured fuels. Outside of the treated areas, effects on fire and fuels would be the same as Alternative A.

Effects in Vegetation States with Pinyon-Juniper

The nature and types of impacts on fire and fuels from pinyon-juniper treatments would be similar to Alternative B but would occur within a 5.6-million-acre potential treatment area instead of within 38.5 million acres. Treatments in Phase III Pinyon-Juniper areas are unlikely. Compared with Alternatives A and C, reducing pinyon-juniper encroachment and tree canopy cover and restoring and augmenting understory vegetation in Phase I and II Pinyon-Juniper areas would lessen or reverse the trend of encroachment and altered fire regimes within larger treated areas. In the short term, reducing biomass and pinyon-juniper tree cover would influence burn patterns and reduce fire intensity by reducing the potential for isolated or group tree torching and crown fires that would contribute to fire spotting in other receptive vegetation states. In the long term, a restored understory would be more resilient to fire and resist subsequent conversion to invasive annual grasses and new encroachment of pinyon-juniper; this would contribute to patchier burn patterns, which would limit the potential for fire to spread and fewer acres burned.

Retaining stringers or clusters of pinyon-juniper trees to support habitat objectives could provide a localized heavy fuel source for fire and may lead to individual trees torching and small areas of crown fires, which may contribute to fire spotting in nearby receptive vegetation states, but adjacent vegetation restoration treatments would limit fire spread in these areas.

Outside of the treated areas, including in Phase III areas, direct effects on fire and fuels would be the same as Alternative A. Even without treatments in Phase III areas, treatments in adjacent Phase I and II areas and other vegetation states would indirectly reduce the potential for fire in Phase III areas.

4.3.8 Cumulative Effects

Past, present, and reasonably foreseeable future projects, plans, or actions that affect fire and fuels are included in **Table 4-1**. Past and present actions influencing the current condition of fire and fuels include fire suppression and fuel breaks, vegetation management projects, ROW development, locatable, saleable, solid, and fluid mineral activity, recreation, and livestock grazing. These uses have altered sagebrush steppe ecosystems. For example, roads, ROWs, and recreation uses are common causes of wildfire ignitions. Roads and ROWs also provide access to potential treatment areas, act as fuel breaks that can slow the spread of wildfires, and provide anchor points for fire suppression.

Livestock grazing can alter vegetation conditions, with impacts on fire regimes; for example, grazing can reduce fuel loading, which can modify fire behavior and burn patterns. It can also create surface disturbance and subsequent recolonization by invasive annual grasses. Ongoing livestock grazing in the project area would continue to influence fire and fuels.

Wildfire is a natural component of the landscape. Fire suppression on public and nonpublic lands in the project area has led to increased fuel loading and increased risk of more frequent, large, contiguous wildfires, especially in vegetation states with an invasive annual grass component. For much of the last decade, most of the western US has experienced drought; drier conditions contribute to changes in vegetation conditions that support large wildfires (USDA and USDOI 2015). Fuel breaks have been and continue to be implemented throughout the project area. Fuel breaks are a tool to aid in fire suppression and influence wildfire behavior in the absence of direct attack suppression (Agee et al. 2000); they complement fuels reduction and rangeland restoration projects by reducing the likelihood of contiguous fires overrunning treated areas and delaying the return to historic fire cycles in treated areas. The implementation of fuel breaks in combination with these treatments is intended to slow the rate of spread and lengthen fire return intervals. Early-season fire would be less likely to spread where there are treatments and fuel breaks in place. However, the combination of factors such as seasonal weather conditions, invasive annual grass encroachment following disturbance, and pinyon-juniper encroachment have resulted in a continued trend toward altered fire regimes at the project area scale.

Restoration treatments throughout the project area, including hazardous fuels reduction, pinyon-juniper removal, seedings, shrub planting, and invasive species control, have restored vegetative structure and function and reduced fuel loading in some areas. This has contributed to more desirable fire regimes on a site-specific level. In other areas, past treatments are incrementally moving vegetation toward desired conditions. However, at the project area-scale, the rapid conversion of disturbed areas to invasive annual grasses and continued encroachment of pinyon-juniper into sagebrush communities and perennial grasslands have hindered the project area-wide success of these treatments. The level of vegetation departure from historic benchmarks continues to increase with associated effects on fire and fuels as described in *Nature and Type of Effects*.

The nature and type of cumulative effects on fire and fuels under the action alternatives (Alternatives B, C, and D) are similar; however, the location, extent, and degree of impacts would vary among the alternatives. Alternatives B, C, and D would provide regional analysis and consultation that could be applied at the site-specific level. This would support tiered NEPA compliance and result in the potential for more fuels reduction and rangeland restoration projects being implemented across the landscape. Combined with past, present, and reasonably foreseeable future actions, treatments under Alternatives B through D would change vegetation composition and structure (see **Section 4.2**, Vegetation), which would change the amount and arrangement of fuels. Over the long term, treatments would shift vegetation to more desired conditions (see **Section 2.2.9**), increase resistance and resilience, and result in more historic fire regimes. The location and magnitude of these cumulative impacts would vary between the action alternatives based on the proposed locations and extent of potential treatments.

Under Alternative B, the effects from past, present, and reasonably foreseeable future actions would result in an increase in opportunities compared with Alternative A to shift vegetation in some areas to a more desired species composition and structure and reduce acres burned, with an associated shift toward historic fire regimes. The cumulative effect of reducing fuel loading in all pinyon-juniper phases, creating diverse age classes in sagebrush communities, and restoring invasive annual grass-dominated vegetation states to perennial grasses and forbs would be a corresponding return of historic fire regimes in treated areas. Treatments implemented under Alternative B would provide opportunities to restore desired vegetation conditions across the greatest portion of the project area. Combined with the activities in **Table 4-1**, treatments would reduce the likelihood that invasive annual grasses would reestablish in the near term. Compared with the other alternatives, this would shift vegetation conditions and associated fire regimes toward desired conditions more quickly. Treatments would result in longer fire return intervals, reduce the probability for contiguous burns, lessen the amount of cured fuels available to carry early-season fires and reduce acres burned. Combined with the implementation of fuel breaks, increasing the resistance and resilience sites through treatments, and ongoing maintenance of fuel breaks and treated areas, fire regimes would incrementally shift toward more desired historic conditions over the long term and would be dependent on the number of ROWs, mineral developments, and extent of public recreation uses. Compared with Alternative A and combined with past, present, and reasonably foreseeable future actions, wildfires would be less likely to burn contiguously across the landscape, resulting in fewer acres burned and treated areas would be likely to have more desirable fire return intervals.

Proposed treatments under Alternative C, combined with past, present, and reasonably foreseeable future actions, would shift vegetation and associated fire regimes toward desired conditions (see **Section 4.2**, Vegetation). Particularly in the Phase I Pinyon-Juniper vegetation state, there would be a cumulative decline in encroachment. However, by not treating in Phase II or Phase III Pinyon-Juniper, Perennial Grasses, Forbs, and Shrubs, and Shrub with Depleted Understory vegetation states and excluding highly resistant and resilient sites from treatments, the cumulative effects in those areas would be the same as Alternative A. Limiting the types of tools to manual and mechanical, including in vegetation states with invasive annual grasses, would limit the options available to shift fuel conditions and fire regimes toward desired conditions in the short term. Over time, incremental disturbance from fire, ROWs, mineral development, recreation use, and grazing would result in more disturbed areas with vegetation states transitioning to those with invasive annual grass components, including in highly resistant and resilient sites. Dense canopy cover in Phase II and III Pinyon-Juniper and Shrub with Depleted Understory areas would continue to spread and would contribute to undesirable vegetation states and fire regimes. Treatments in Phase I areas may not be sufficient in the near term to reduce fuel loading in those areas to the level necessary to alter fire regimes. The result would be a continuation of contiguous wildfires in untreated areas with the potential to spread to recently treated areas that have not fully achieved desired vegetation conditions. Continuation of altered wildfire behavior, combined with limited seeding and treatment methods for maintaining treated areas and increased potential for fire starts in cured fuels along new or more heavily used roads and ROWs, could reduce the ability of treatments to restore historic fire regimes because the rate of departure in adjacent nontreated areas would outweigh the restorative capacity of treated areas.

The types of treatments under Alternative D, combined with past, present, and reasonably foreseeable future actions, would result in a similar likelihood of shifting vegetation states and associated fire regimes toward desired conditions as Alternative B; however, treatment areas would be smaller and there would be fewer areas where the associated cumulative outcomes would occur. The cumulative effect of reducing fuel loading and restoring the understory in Phases I and II Pinyon-Juniper areas, creating diverse age classes in sagebrush communities, and restoring invasive annual grass-dominated grasslands to perennial grasses and forbs would be similar to Alternative B. Combined with the activities in **Table 4-1**, treatments would reduce the likelihood that invasive annual grasses would reestablish in the near term, which compared with Alternative A would shift vegetation conditions and associated fire regimes toward desired conditions more quickly. Combined with the implementation of fuel breaks, enhancement of highly resistant and resilient sites through treatments, and ongoing maintenance of fuel breaks and treated areas, fire regimes would incrementally shift toward more desired historic conditions over the long term. The rate and extent of the shift toward desired conditions would be dependent on the number of ROWs, mineral developments, and extent of public recreation uses and areas available for livestock grazing. Outside of the treated areas, including in Phase III Pinyon-Juniper areas, effects on fire and fuels would be the same as Alternative A.

In the short and long term, under Alternative A, disturbance from past, present, and reasonably foreseeable future actions would incrementally increase the number of acres transitioning to vegetation states with invasive annual grass components. These impacts would depend on the number and acres of activities occurring in the project area. Implementing project-specific best management practices, emergency stabilization and recovery treatments, and reclaiming disturbed areas could potentially reduce the extent of areas transitioning to vegetation states with invasive annual grasses following disturbance. Combined with past, present, and reasonably foreseeable future actions, the action alternatives would reduce the extent of fine fuels and pinyon-juniper encroachment while shifting vegetation states toward desired conditions. In the long term, these desired conditions would result in fire regimes that align with historic conditions and reduce the potential for subsequent departure from historic fire regimes.

4.4 AIR QUALITY

4.4.1 Assumptions

- Vegetation treatments that reduce hazardous fuels buildup or improve ecosystem health, thereby reducing the acres burned or the intensity of wildfire, would benefit local and regional air quality over the long term.
- Prescribed fire would produce less smoke than wildfires because the meteorological and fuel load conditions under which burns occur can be controlled. On a per-acre basis, emissions from unplanned or high-severity wildfires can be substantially higher than during prescribed fire (North et al. 2012).
- Impacts of treatment methods would be temporary, localized, and intermittent; impacts of prescribed fire would be greater than other treatment methods but would be subject to state smoke management regulations and environmental design features related to prescribed fire (Design Features 9-14, **Appendix D**). The primary pollutant of concern would be $PM_{2.5}$ (NWCG 2018b).

4.4.2 Nature and Type of Effects

Effects Common to All Treatment Methods

All treatment methods would have direct impacts on air quality from vehicle- and equipment-related exhaust emissions. Ground vehicles used to access treatment locations and powered equipment used to perform the treatments would emit criteria pollutants and small amounts of hazardous air pollutants through combustion of fossil fuels, such as diesel fuels and gasoline. Because these emissions would be temporary and intermittent, they would not affect local or regional air quality conditions. The most significant pollutant of concern is $PM_{2.5}$ (NWCG 2018b).

Travel on unpaved roadways to access treatment areas would be direct sources of particulate matter in the form of fugitive dust. Emissions would be localized to the area surrounding the roadway and would cease when that activity ends and the entrained dust settles. Localized increases in particulate matter would not substantially increase local or regional levels of particulate matter.

The outcomes of programmatic vegetation management in pinyon-juniper, sagebrush, and invasive annual grassland vegetation communities would alter fire regimes in the ways described in **Section 4.3.3**, *Fire and Fuels, Nature and Type of Effects*. This would have indirect impacts on air quality in the project area by lengthening the fire return interval, reducing available fuels during fire season, restoring natural burn patterns, and changing and reducing acres burned, thereby reducing annual wildfire-related emissions.

Effects from Manual Treatments

There would be no impact on air quality from the use of non-powered hand tools other than those described above.

Effects from Mechanical Treatments

Some types of mechanical treatments may be sources of fugitive dust from ground disturbance during treatments. Emissions would be localized to the area surrounding any given ground-disturbing activity and would cease when that activity ends and the entrained dust settles. Temporary disturbance areas would be susceptible to windblown soil erosion until soils are stabilized through vegetation cover. Improved vegetative conditions in restored areas would stabilize soils, thereby decreasing the potential for wind erosion.

Effects from Prescribed Fire Treatments

Prescribed fire to reduce or modify fuel loads and pile burning to burn vegetation that has been removed using manual or mechanical methods can cause locally elevated particulate matter concentrations. This could reduce visibility and affect public health by causing respiratory complications for certain individuals. Prescribed fire also emits carbon monoxide, nitrogen oxide, sulfur oxide, and volatile organic compounds. Prescribed fire would temporarily reduce air quality until the gases and particulates that make up smoke dissipate. Burned areas would be susceptible to windblown soil erosion until they are revegetated and the exposed soils are stabilized.

Emissions from prescribed fires could exceed air quality standards, primarily for $PM_{2.5}$ (NWCG 2018b). Because of the potential impacts on air quality and visibility from prescribed fire in an airshed, this activity is regulated by states through state smoke management programs (see **Appendix D**, Design Feature 11). This is particularly the case when there is a combination of multiple burn activities or when there are prolonged impacts from poor meteorological conditions, such as temperature inversions, that prevent smoke from dispersing (NWCG 2018b).

Smoke management agencies coordinate and, if necessary, limit prescribed fires in an airshed to minimize smoke-related impacts on air quality, human health, and visibility. Burning within the prescriptions, regulations, and best management practices of each smoke management program minimizes smoke emissions and their associated impacts.

Effects from Chemical Treatments

Chemical treatments would be temporary sources of small amounts of volatile organic compounds. As described in the BLM Vegetation Treatments Using Herbicides Final Programmatic EIS (BLM 2007, p. 4-10) and the Vegetation Treatments Three New Herbicides Final Programmatic EIS (BLM 2016a, p. 4-7), none of the approved chemical treatments would result in substantial volatilization from soils based on their vapor pressures; therefore, these treatments would not affect air quality through volatilization.

Effects from Targeted Grazing Treatments

Targeted grazing would have negligible impacts on air quality, as air pollutant emissions would be limited to equipment used to transport livestock to and from the treatment locations.

4.4.3 Effects from Alternative A

Under Alternative A, restoration projects would continue to take place on a site-specific basis. Impacts on air quality from treatment activities would be as described under *Nature and Type of Effects.* These impacts would continue to occur as restoration projects are implemented on a case-by-case basis.

As described in **Section 4.3.4**, Fire and Fuels, Effects from Alternative A, implementing restoration projects on a site-specific basis without programmatic analysis could result in a continuation of altered fire regimes. Wildfire trends resulting from altered fire regimes would continue to indirectly affect air quality; these trends include shorter fire return intervals, continued or increased availability of fuels, and an increase in the average number of acres burned annually. Deterioration in air quality conditions would occur over the short term (annual wildfire seasons) and the long term (over many seasons) in areas of high or repeated fire occurrence. Wildfire events also may expose soils, making them susceptible to windblown erosion until natural vegetation recovery or postfire restoration is adequate to prevent soil movement by wind.

4.4.4 Effects from Alternative B

Under Alternative B, restoration projects would be allowed in all vegetation states and in all three pinyon-juniper phases to achieve the desired conditions described in **Section 2.2.9**. A full suite of treatment methods would be available overall, with some constraints on treatment methods in some vegetation states and pinyon-juniper stand phases, as shown in **Table 2-1**. Emissions from the use of prescribed fire, targeted grazing, and manual, mechanical, and chemical treatments would be as described under *Nature and Type of Effects*. These emissions, which would be temporary and intermittent and would last for the duration of treatment, would be greater than under Alternative A, as more acres would be treated.

To prevent any potential for violating air quality standards, the BLM would follow the prescribed fire measures described in **Section 2.3.3**, Prescribed Fire; the smoke management program requirements of each state; and the required design features described in **Appendix D** (Design Features 9-14). These measures would ensure that all prescribed fire operations follow their respective burn plans, that debris piles are ignited only when soils are wet or frozen, that all operations comply with state requirements to ensure that emissions remain below NAAQS $PM_{2.5}$ thresholds, that warning signs are posted to alert drivers of the potential for reduced visibility, that atmospheric conditions are within prescriptions when a prescribed fire is ignited and smoke is monitored throughout the burn, and that ignitions are stopped if smoke threatens unacceptable impacts on transportation safety or communities.

Under Alternative B, restoration projects would be possible within the 38.5 million acre potential treatment area. As described in **Section 4.3.5**, Fire and Fuels, Effects from Alternative B, the indirect effects on fire and fuels from implementing restoration projects that build more resistant and resilient vegetation communities would be a reduction in available fuels; lengthened fire return intervals; increased resistance to invasive annuals and resilience to disturbance, such as wildfires; and a reduction in acres burned due to the return of more natural mosaic burn patterns. This would occur in all vegetation states as treatments are implemented over time. Over the long term, indirect impacts on air quality from wildfire-related emissions would be reduced compared with Alternative A.

4.4.5 Effects from Alternative C

Under Alternative C, restoration projects would be implemented within the 22.5 million acre potential treatment area in vegetation states and phases of pinyon-juniper as described in **Table 2-2**; only manual and mechanical treatment methods would be used to achieve the desired conditions described in **Section 2.2.9**. Emissions from these treatment methods would be as described under *Nature and Type of Effects*. Emissions from treatment activities may be greater than under Alternative A, to the extent that more restoration projects would be implemented across the project area. There would be no impacts from chemical treatments, prescribed fire, or targeted grazing, as these tools would not be used under Alternative C. Given the limited treatment methods that would be used under this alternative, there would be a low potential for violating air quality standards.

The effects on fire and fuels would be similar to those described above under Alternative B. Compared with Alternative A, Alternative C would increase opportunities for restoration projects over large areas. These treatments would begin to shift vegetation to a more desired species composition and structure, though to a lesser degree and in fewer acres and vegetation states than described for Alternative B. Compared with Alternative A, indirect impacts on air quality from wildfire-related emissions would be reduced as treatments are implemented over time.

4.4.6 Effects from Alternative D

Under Alternative D, restoration projects would be as described under Alternative B, but would occur within a 5.7-million acre potential treatment area that corresponds to the FIAT planned treatment areas. Treatments are unlikely to occur in Phase III Pinyon-Juniper areas, as these areas were not included in the FIAT assessment. Direct impacts from treatment activities would be as described for Alternative B in areas where treatments would occur, and measures to prevent any potential violations of air quality standards would be the same as described for Alternative B. Emissions would be greater than under Alternative A, as more acres would be treated.

The effects on fire and fuels as a result of Alternative D would be similar to those described under Alternative B. Indirect impacts on air quality from wildfire-related emissions would be reduced compared with Alternative A.

4.4.7 Cumulative Effects

The cumulative effects analysis area for air quality is the air basins in and overlapping the six-state project area. This is because air pollutants from multiple sources combine in an air basin and also may be transported to downwind areas. Past, present, and reasonably foreseeable future actions (see **Table 4-1**) that could cumulatively affect air quality are suppression, vegetation treatments, fuel break projects, development, roads and ROWs, the spread of invasive weeds, and wildfire trends.

The buildup of fuel loads as a result of fire suppression and the spread of noxious weeds and invasive plants have contributed to increased wildfire severity and intensity in the project area (Bracmort 2013; Brooks and Lusk 2008). Drought interacts with these and other factors to further affect fire behavior (Littell et al. 2016). As a result, the project area has seen a shortened fire return interval and an intensified fire season. This has affected air quality and visibility in areas of the Great Basin by generating increased amounts of smoke and ash. It has also resulted in increased amounts of fugitive dust from exposed soils due to wildfire. As described in **Section 3.3.2**, $PM_{2.5}$ concentrations showed an increasing trend in northwestern states from 1998 to 2016 due to wildfire, while showing a decreasing trend in the rest of the contiguous United States (McClure and Jaffe 2018).

Individual vegetation management actions have been implemented to address the effects of wildfire, as have individual fuel break projects. These actions have had localized, temporary impacts on air quality similar to those described under *Nature and Type of Effects*. Over the long term, individual vegetation management actions have improved vegetation conditions in limited areas, indirectly affecting air quality by improving resistance and resilience and reducing wildfire effects in these areas. Individual fuel break projects have reduced the impacts of wildfire on air quality in limited areas by improving fire suppression opportunities and decreasing the potential for wildfires to spread. These actions combined, however, have been unable to reduce overall trends in wildfire occurrence in the Great Basin and the resulting impacts on air quality.

Roads, ROWs, and energy and mineral developments on public lands would continue to be a source of fugitive dust emissions, primarily from travel on unpaved surfaces for recreation, access and maintenance of ROWs, and access to energy and mineral developments. These actions, in combination with other sources of fugitive dust and emitted particulate matter, such as transportation sources, power generation facilities, woodburning, and wildfire, have reduced visibility at some Class I areas and caused some areas in the Great Basin to be designated as nonattainment for $PM_{2.5}$ (see **Map 15**).

Cumulative impacts common to all action alternatives would occur from restoration treatments. These would include direct impacts on air quality from equipment and vehicle exhaust and fugitive particulate matter from travel on unpaved roadways and treatment-related ground disturbance, as described under *Nature and Type of Effects*. As more treatments are implemented over time, impacts on air quality from smoke would be reduced by reducing available fuels, lengthening fire return intervals, increasing resistance and resilience to wildfires, and reducing acres burned due to the return of more natural mosaic burn patterns. The relative contribution to cumulative impacts from each action alternative would differ, based on the treatment areas and methods proposed under each action alternative.

Under Alternative B, restoration projects would occur over the greatest area using a full suite of treatment methods, including prescribed fire. Direct impacts from treatment activities would be the greatest of all the alternatives, particularly from projects that use prescribed fire. As described under *Nature and Type of Effects*, smoke management agencies regulate prescribed fire activities to avoid cumulative impacts from multiple burn activities within an airshed to maintain compliance with ambient air quality standards. As such, Alternative B would not result in a cumulatively significant impact on air resources from use of prescribed fire. Combined with other past, present, and reasonably foreseeable vegetation management actions in the project area, the potential increase in the amount of restoration under Alternative B could reduce available fuels, lengthen fire return intervals, increase resistance and resilience to wildfires, and reduce acres burned due to a return to more natural mosaic burn patterns in more areas of the Great Basin. This would result in a greater cumulative improvement in air quality compared with Alternatives A, C, and D.

Alternative C would have the fewest impacts on air quality from treatment activities. This is because treatment tools would be limited to mechanical and manual methods. Combined with other past, present, and reasonably foreseeable vegetation management actions in the project area, the potential increase in the amount of restoration under Alternative C could produce the changes described in Alternative B to a lesser degree. This would result in a cumulative improvement in air quality more than under Alternative A but less than under Alternatives B and D.

Impacts under Alternative D would be similar to those described for Alternative B, but they would occur in fewer areas. The direct impacts from treatment activities would be less than described for Alternative B. Combined with other past, present, and reasonably foreseeable vegetation management actions in the project area, the potential increase in the amount of restoration under Alternative D could produce changes similar to those described in Alternative B but in fewer areas. This would result in a greater cumulative improvement in air quality compared with Alternatives A and C but less than under Alternative B.

The BLM's reasonably foreseeable PEIS for Fuel Breaks in the Great Basin would improve fire suppression opportunities, slow the rate of wildfire spread, and provide protection for restored areas. These two actions—regional approaches to fuel breaks and to rangeland restoration—in combination would have the greatest potential to improve ecological site conditions and lengthen the fire return interval. At the same time, they would improve fire suppression opportunities such that fire severity and intensity would be reduced across the Great Basin. This would cumulatively reduce smoke and particulate matter emissions over the long term. This effect would be the greatest under Alternative B.

4.5 CLIMATE

4.5.1 Assumptions

- Nothing proposed in the action alternatives would measurably affect climate change; as such, a detailed analysis of each alternative has not been conducted.
- Current climate change projections indicate an added competitive edge for cheatgrass in the Great Basin.
- Healthy intact native vegetative communities have the best opportunity to adapt to a changing climate.
- Shortened fire return interval and increases in invasive annual grasses inhibit a native communities' ability to adapt to climate change.
- Carbon sequestration is higher in intact native systems compared with invasive annual grasslands with a shortened fire return interval.

4.5.2 Nature and Type of Effects

Over the long term, any reduction in size of wildfires or total acres burned as an indirect result of restoration treatments would reduce or prevent additional carbon release and maintain the carbon sequestration ability of the vegetative community that, through such treatments, has gained improved structure and function.

Changes in climate may alter the growing conditions of a specific site and make it more difficult for native vegetation to reestablish. Each degree Celcius of warming is predicted to result in the loss of 12% of sagebrush in the intermountain west and allow for additional expansion of cheatgrass (Chambers and Pellant 2008).

4.6 SOIL RESOURCES

4.6.1 Assumptions

- Soil instability increases as slopes become steeper, especially for soils that are susceptible to water erosion. For recently burned soils, there is increased potential for wind to cause soil erosion on level ground (Wagenbrenner et al. 2011). Highly erosive soils would be at greater risk to potential surface-disturbing activities than other less erosive soils.
- Over the long term, restoration projects that remove invasive and dense, woody vegetation and restore native plants should increase water availability and reduce soil erosion (Pierson et al. 2013).
- Disturbed soils from targeted grazing would surround water sources and mineral supplement locations; such impacts would occur throughout the duration of the treatment period, lasting weeks to months after the treatment.
- Biological soil crusts are less likely to occur in sites that have incurred multiple disturbances, such as repeated fires (USGS 2001; Condon and Pyke 2018). Less herbaceous cover, which is ideal for crust development, makes biological soil crusts more prevalent at lower elevations compared with higher elevations; moss and lichen cover increases with elevation and precipitation until the herbaceous cover is more prevalent (USGS 2001).
- Soils within the Invasive Annual Grasses vegetation state would have enhanced rates of decomposition, which may result in depletion of long-term soil organic matter (Norton et al. 2004).

4.6.2 Nature and Type of Effects

In general, short-term effects on soils include an increased potential for soil erosion due to removal of vegetation cover and changes in soil structure, porosity, or organic matter content due to compaction and surface disturbance. These impacts are amplified in areas with dense, woody vegetation and invasive annual grasses. Encroaching pinyon-juniper inhibits growth of understory vegetation and results in bare soil that is susceptible to erosion (Pierson et al. 2013). In areas where invasive annual grasses dominate the landscape, shortened fire return intervals inhibit native vegetation growth and decrease ecosystem resistance (Chambers et al. 2014b).

Over the long term, removal of invasive or dense, woody vegetation and reseeding of native vegetation would increase biological diversity and organic matter. These would maintain soil stability and improve water infiltration rates, decreasing the likelihood for wind and water erosion; overall, these would potentially increase ecosystem resilience to fire disturbance. In areas where biological soil crusts are disturbed, impacts on crust integrity can take up to 250 years to recover depending on the species composition (USGS 2004). For example, lichens may take several decades to recover, but mosses are the most resilient to disturbance and can recover within the first few decades of disturbance (Condon and Pyke 2018).

Effects from Manual Treatments

Manual treatments with hand tools would allow for more selective removal of vegetation and would minimize soil compaction and soil disturbance. Localized soil disturbance and soil compaction could initially occur from vehicles accessing treatment sites. The action alternatives would not restrict vehicle access to existing roads and trails, so vehicles could affect highly erosive soils that are not usually exposed to tire tracks. Especially on biological soil crusts, as the US Geological Survey describes, these impacts would decrease aggregate stability, organic matter, and soil nutrients, which could decrease organism diversity (USGS 2004). Manual treatments would have less direct effects on soils than the other proposed treatments.

Effects from Mechanical Treatments

Soils, including biological soil crusts, could be compacted or disturbed from heavy machinery used for mowing, seedbed preparation, tilling, drill seeding, and masticating. Soil compaction can break apart soil aggregates, which directly affects water infiltration, air movement, and the rate of chemical transport in soils by reducing the pore space between aggregates and increasing bulk density. In areas where biological soil crusts are present, direct impacts on them could decrease aggregate stability and degrade organic matter, making soils even more susceptible to erosion.

Short-term impacts on biological soil crusts would be the same as described by Belnap (1994). This study demonstrates that disturbance of biological soil crusts would indirectly affect soil nutrient availability as these crusts contain organic matter and nitrogen-fixing microorganisms. This disturbance would also have an indirect impact on native vegetation diversity, as biological soil crusts provide soil stability and essential plant nutrients that foster plant survival (Ferrenberg et al. 2017). Organic matter disturbance from masticator treatment can be avoided by ensuring that the produced mulch is in contact with the soil surface to promote decomposition and nutrient cycling (Halbrook et al. 2006). Treatment debris, however, would do little to curb initial soil erosion (Pierson et al. 2013).

Over the long term, removal of invasive or dense, woody vegetation that inhibits understory vegetation growth, and reseeding of native vegetation would increase biological diversity, organic matter, and ecosystem resistance. This would benefit soils and biological soil crusts by stabilizing soil aggregates, decreasing erosion potential, and increasing nutrient availability; thus, it would increase the potential for ecosystem resilience to future disturbance

Effects from Targeted Grazing Treatments

Domestic animals and associated infrastructure could damage biological soil crusts at treatment sites through physical disruption, including shearing and compacting soil. This would decrease water infiltration rates and increase soil erosion (Belsky and Blumenthal 1997). The BLM would use the appropriate livestock type(s), according to the vegetation type(s) being treated, to reduce or avoid grazing pressure on native species. Tate and others explain that grazed sites have higher compaction, as evidenced by the higher bulk density, than ungrazed sites (Tate et al. 2004). Effects would vary, based on intensity and duration of grazing and the type of livestock., but would be most pronounced around watering and supplement locations. Furthermore, Russell and others explain that cattle would affect the uniformity of the soil horizon, including biological soil crusts, by breaking the crust and forming indentations that increase surface roughness (Russell et al. 2001). Loss of biological soil crusts would directly affect soil stability, water infiltration, and nutrient cycling.

Long-term effects of targeted grazing would be as described by Mosely and Roselle (2006). The authors explain that when grazing treatments are applied selectively, reduction of invasive annual grasses and noxious weeds result in increased cover of native grasses and forbs. The increased cover of native species improves soil stability and promotes organism diversity and nutrient cycling, which in turn increase water infiltration rates.

Effects from Prescribed Fire Treatments

Direct, short-term impacts on soils from prescribed fire for fuels reduction, seeding, and fireline construction would include removal of vegetation, volatilization of organic matter, and damage to soil biological crust. For fireline construction especially, the removal of soil surface stabilizers, such as vegetation and biological soil crusts, would expose bare mineral soils. This would reduce resistance to degradation, especially for highly erosive soils. Localized pile or Jackpot burning would transfer heat into the soils, exposing the soil to thermal extremes, which would have a direct impact on soil nutrient availability and soil porosity, limiting water infiltration (Busse et al. 2010). However, fire severity for jackpot burning is expected to be low; fire severity for pile burning could be moderate to high, but would be confined to small, localized areas. This could result in water-repellant soils that lack cohesion between soil particles and are more susceptible to wind or water erosion. Dry conditions already persist in regions of the Great Basin. Aridisols, which are characterized as dry soils with low infiltration rates, are the most common soil type in the project area (see **Section 3.5**).

Depending on the severity of soil disturbance, vegetation may reestablish in the first few years following prescribed fire treatments; if soils are sterilized, several years of soil deposition may be needed before soils would support vegetation again, thus affecting the growing conditions for future vegetation communities (Busse et al. 2010). Native vascular plant species have adaptations that allow them to survive on burned biological soil crusts with varying surfaces (smooth to rough), but if burning results in removal of crusts, exotic plant germination would increase (Hilty et al. 2004).

Removing woody vegetation by prescribed fire treatments could increase soil moisture availability (Rau et al. 2008). Initially, some plant nutrients would be lost to volatilization while nutrient levels, soil pH, and organic matter would increase in soil after exposure to fire in the first few years following treatment (Rau et al. 2008). The removal of Pinyon-Juniper would increase water availability in soil and increase sunlight availability for understory vegetation allowing for eventual recovery of the understory, including biological soil crusts, several years following treatment.

Effects from Chemical Treatments

Chemical use would reduce the amount of standing above ground vegetation indirectly decreasing organic matter and nutrient availability, and would increase erosion susceptibility (BLM 2016a). Overall, impacts would not be uniform because chemical treatments have varying half-life ranges (between a few days and up to a year) and degrade at different rates depending on the type of chemical treatment used (BLM 2016a). Impacts would also depend on soil texture; soils with more clay and organic matter tend to hold water and dissolved chemicals longer (LaPrade 1992). Most of the soils in the project area are low in organic matter content (see **Section 3.5**) and are more likely to leach herbicide constituents (BLM 2016a). Chemical treatment application in areas with biological soil crusts can alter crust species composition, but these treatments also eliminate invasive annual grasses that decrease biological soil crust cover (BLM 2016a). This would result in more favorable conditions for biological crust establishment in the decades following treatment. Over the long term, using chemical treatments to remove invasive annual grasses and noxious vegetation would help alter wildfire seasonality and create more desired burn patterns, which would indirectly benefit highly erosive soils and biological soil crusts by decreasing erosion susceptibility.

4.6.3 Effects from Alternative A

Under Alternative A, future fuels reduction and rangeland restoration projects would continue to take place on a site-specific basis only. See *Vegetation Management* in **Table 4-1** for a partial list of these site-specific projects, which collectively have or will continue to treat potentially millions of acres and contribute to establishing ecosystem resistance and resilience in those areas. However, there would be no regional programmatic analysis to support tiered NEPA compliance and subsequent treatment implementation, which could allow for the continued conversion of native vegetation to cheatgrass and other invasive annual grasses. This conversion would continue the frequent fire return interval in the project area. More frequent fires would damage existing soils and biological soil crusts and clear vegetation, which would strip soil nutrients and increase the potential for wind and water erosion. In turn, native vegetation may not reestablish. This could also limit soil infiltration rates and create water-resistant soils, which would increase the risk of water erosion. Compared with the action alternatives, there would be less direct impacts of soil compaction, soil erosion potential, or both, on biological soil crusts and highly erosive soils due to vegetation removal, prescribed fire, or targeted grazing; however, large-scale soil erosion would be possible following wildfires.

4.6.4 Effects from Alternative B

Under Alternative B, approximately 882,000 acres of highly erosive soils would be within the potential treatment area (**Table 4-2**). This alternative would use all available tools outlined in **Table 2-1**, and treatment would be allowed in areas with sagebrush cover, Phase III Pinyon-Juniper areas, and low to moderate resistant and resilient sites. In addition, Alternative B would allow the use of native and nonnative plant material.

Table 4-2
Impacts on Soil Resources for the Action Alternatives

Alternative	Highly Erosive Soils in Potential Treatment Area (Acres)*
Alternative B	882,000
Alternative C	708,000
Alternative D	63,000

Source: BLM GIS 2018
*High WEG soils or soils with high wind erosion potential in wind erodibility groups 1 and 2 (see **Section 3.5**)

Effects specific to vegetation states found in the treatment area are described below. See **Table 2-1** for an outline of treatment methods by vegetation state.

All treatment methods would be allowed for restoration treatments (see **Table 2-1**) in Invasive Annual Grasses and Invasive Annual Grasses and Shrubs, which would increase surface disturbance on highly erosive soils and increase the soil erosion potential, as described under *Nature and Type of Effects*. Disturbance to biological soil crusts would be minimal, if at all, in these vegetation states. This is because crusts would be previously lost to fire disturbance and colonization of invasive annual grass. For areas within the Invasive Annual Grasses and Invasive Annual Grasses and Shrubs vegetation states, surface disturbance from targeted grazing and mechanical and manual seedbed preparation and planting, as described under *Nature and Type of Effects*, would occur on soils and biological soil crusts in the first few years of treatments. Domestic animals used for targeted grazing treatments in would break the soil surface, including any biological soil crusts, with their hooves and expose the soil surface to wind and water erosion. The BLM would intensively manage grazing under Alternative B by fencing or herding to avoid surface disturbance on soils beyond targeted areas. Targeted grazing would also be conducted at the appropriate time of the year and would use appropriate livestock types, based on the species being treated. These restrictions, combined with Design Feature 15, which would require rest from grazing, would allow for native plant establishment and site stabilization.

Pile, jackpot, and broadcast burning treatments of Pinyon-Juniper, and treatments in Invasive Annual Grasses and Invasive Annual Grasses and Shrubs could increase the potential for erosion, especially in highly erosive soils. Additional effects could result in the volatilization of organic matter and the loss of biological soil crust; which would reduce water infiltration rates. The BLM would identify and manage prescribed fire treatment locations for pile and broadcast burning in accordance with Design Features 10 and 21. This would limit soil compaction from operational equipment and restrict burning on dry soils (see **Appendix D**). If the desired vegetation is established (see **Section 2.2.9**), soil aggregate stability would increase and the potential for soil erosion would decrease in several years following treatments.

Targeted grazing would be utilized in Nonnative Perennial Grasses and Forbs, which would result in impacts similar to the Invasive Annual Grasses vegetation state. In Native Perennial Grasses and Forbs, targeted grazing and other restoration treatments would not be used; however, mechanical interplanting would be used for restoration in both vegetation states, which would increase surface disturbance and the erosion potential to soils and damage biological soil crusts in native areas. This restoration treatment would also be implemented in Nonnative Perennial Grass and Forbs. See **Section 2.2.9** for the desired vegetation conditions.

In Perennial Grasses, Forbs, and Shrubs (both native and nonnative), treatments would be unlikely to occur. This is because the main objective would be preservation. This vegetation state generally resists accelerated erosion and allows for soil development.

For Perennial Grasses and Forbs and Perennial Grasses, Forbs, Shrubs and Invasive Annual Grasses, reduction of invasive annual grass would occur using targeted grazing and selective preemergent chemical treatment. These treatments would be used to reduce fuels in preparation for restoration treatments such as mechanized interseeding and interplanting. Manual planting and mechanical seed cover would be used specifically in areas with Perennial Grasses, Forbs, and Invasive Annual Grasses where the desired outcome would be Perennial Grasses and Forbs or Perennial Grasses, Forbs, and Shrubs. The selective application of these treatment methods would limit surface disturbance and erosion potential compared with soils and biological soil crusts in the other vegetation states.

Restoration treatments in Shrub with Depleted Understory would increase short-term impacts on soils and biological soil crusts via compaction and surface disturbance, which would increase soil erosion. Biological soil crusts would be at the most risk of disturbance. This is because biological soil crusts are most likely to occur in this vegetation state due to the presence of shrubs and the absence of fire disturbance. Following surface disturbance, such as compaction or breaking of crust, biological soil crusts can take decades to recover (depending on species composition), as described under *Nature and Type of Effects*. If the desired vegetation outcome is achieved (see **Section 2.2.9**), restoration of understory vegetation would increase soil aggregate stability and water infiltration and reduce the potential for soil erosion.

Treatments in encroaching pinyon-juniper would occur in all phases of pinyon-juniper. The effects of these treatments would be the same as those described under *Nature and Type of Effects* for mechanical, manual, and prescribed fire treatments. Design Features 2, and 29-33, applicable to all action alternatives, could minimize compaction and erosion as a result of ground-disturbing treatments on soils with high WEG values, steep slopes, high cover of biological soil crusts, and previously disturbed soils (see **Appendix D**). Impacts on plant nutrient availability would be minimal and related to areas of surface disturbance. Slopes of 35 percent or more would be avoided for mechanical treatments in Phase I and II Pinyon-Juniper under Design Feature 30, which would reduce impacts on highly erosive soils.

Limitations on mechanical treatments and pile, jackpot, and broadcast burning in certain Phase I Pinyon-Juniper areas would limit heating, exposure of bare minerals, and water repellency on soils that have already been burned. Reduction of encroaching pinyon-juniper in Phase I Pinyon-Juniper that could transition into Phase II would reduce the potential for a crown fire, decreasing soil erosion potential, and would result in a desired outcome of Perennial Grass and Forbs and Shrub vegetation. In Phase II Pinyon-Juniper, where understory is lacking after reduction of pinyon-juniper cover, these areas would be revegetated to the desired vegetation condition (see **Section 2.2.9**) based on the adjacent plant community, which would improve soil function and associated processes.

For the above restoration treatment methods, the use of both native and nonnative seed would increase the likelihood of seeding success and limit follow-up treatments, which in turn would limit reduction of organic matter, soil compaction, and soil erosion related to surface disturbance. Alternative B would have more potential to convert invaded rangelands to desired vegetation conditions than Alternative A.

This is because it would have the potential to treat more acres with all available treatment methods. Attainment of desired conditions would reduce continuous fuel loading and alter the pattern of wildfire movement. In turn, this would reduce the potential for disturbance to soils and improve soil health.

4.6.5 Effects from Alternative C

Under Alternative C, approximately 708,000 acres of highly erosive soils would be within the potential treatment area (**Table 4-2**). These areas with highly erosive soils would be limited to manual and mechanical treatment methods for fuels reduction and rangeland restoration.

Direct treatment of sagebrush cover would be avoided, which would reduce impacts on native vegetation and prevent soil disturbance in areas with sagebrush cover. Alternative C would allow vegetation treatments in low to moderate resistant and resilient sites, which could result in soil disturbance, making these sites less resistant or resilient in the short term to future wildfires and invasion of invasive annual grasses.

Treatments under Alternative C would result in soil disturbance, as described under *Nature and Type of Effects* for manual and mechanical treatments. This would include vegetation removal and soil compaction, which would increase wind and water erosion susceptibility. The use of heavy machinery for seeding would reduce the amount of biological soil crusts, especially in vegetation states requiring more treatment, or using more invasive treatments like disks or plows as described in Alternative B, and result in a decrease to soil stability and nutrient cycling in the first few years after treatments. See **Section 4.2.5** for a detailed description of treatments utilized for each vegetation state under Alternative C. The desired conditions would be the same as those under Alternative B; however, only native plant material would be used, which would limit the feasibility of achieving the desired conditions (see **Section 2.2.9**).

Several years after treatment, removing nonnative vegetation and reseeding with native plant material would increase plant diversity, which would improve chemical, biological, and physical soil properties; however, native species are more selective of soil types and nutrients than their invasive competitors, which would limit their ability to establish (Ott et al. 2016). Maintenance, therefore, would be ongoing to monitor native seeding success; failure to establish after initial treatment could result in multiple treatments that increase surface disturbance and the erosion potential on highly erosive soils and biological soil crusts.

Treatment in encroaching pinyon-juniper woodlands would be limited to manual treatments in Phase I areas; impacts on soils would be as described in *Nature and Type of Effects.* Alternative C includes manual and mechanical treatments, but it would use fewer treatment methods than some of the individual fuels reduction and rangeland restoration projects that would continue under Alternative A. This means targeted grazing, prescribed fire, and chemical treatments would still be implemented on a site-specific basis, without regional programmatic analysis to support tiered NEPA compliance, as described under *Effects from Alternative A*.

4.6.6 Effects from Alternative D

Under Alternative D, approximately 63,000 acres of highly erosive soils would be within the potential treatment area (**Table 4-2**). Alternative D would use the same treatment methods and tools available under Alternative B (see **Section 4.2.6** for a detailed description of treatments utilized for each vegetation state under Alternative D). Therefore, the short-term and long-term impacts of treatments on soils and biological soil crusts would be similar to those described in *Effects from Alternative B*. The treatments, however, would be limited to FIAT planned treatment areas, which do not include Phase III Pinyon-Juniper vegetation states. Treatment areas would be prioritized based on the threat of invasive species and pinyon-juniper encroachment, and the potential for postfire rehabilitation (**Section 1.3**). In the long term, treatments would increase ecosystem resistance to invasive vegetation and lengthen fire return intervals to increase ecosystem resilience to future wildfires. Increasing resistance and resilience would help achieve desired conditions (Section 2.2.9) and provide long-term protection of soil resources as described in *Nature and Types of Effects*.

Since Phase III Pinyon-Juniper is not likely to be treated under Alternative D, these dense, woody vegetation states, outside the FIAT planned treatment areas, would continue to be at risk of intense crown fires and rapid fire spread to adjacent vegetation states. Like Alternative A, while soil erosion would be avoided initially, this would reduce ecosystem resilience to future wildfires in Phase III Pinyon-Juniper woodlands and increase the potential for soil erosion in the long term. In all other vegetation states, increased vegetation diversity would improve soil health several years after treatments, which would increase soil aggregate stability, organic matter, and water infiltration. Alternative D would treat a similar number of acres as the site-specific projects that have and will continue to be implemented under Alternative A; however, the potential treatment areas under Alternative D would use all available treatment methods and include FIAT planned treatment areas that have been selected for their potential to have postfire rehabilitation success.

4.6.7 Cumulative Effects

Effects are not expected to extend beyond the project area. This is because impacts on soils would be localized to treated areas. Due to the large project area and localized effects from treatments, the effects on soils would not be uniform across the project area. The Great Basin has a variety of soil types, and biological soil crusts are not evenly distributed (see **Section 3.5**). The BLM would continue to monitor and treat invasive annual plants long after initial treatments, so indirect effects on soils would continue up to several decades after treatment.

Past, present, and reasonably foreseeable human actions and natural processes have improved soil conditions through vegetation management and fuel break projects; however, fire suppression during the twentieth century has increased fuel loads in the Great Basin (**Table 4-1**). This has contributed to more severe wildfires that increase soil erosion and destruction of biological soil crusts as described under *Effects from Alternative A*.

Past, present, and reasonably foreseeable livestock grazing projects and such developments as mineral leasing and land use projects (**Table 4-1**) have increased and would continue to increase surface disturbance. Construction of transportation routes for OHVs, recreation, and other uses is a reasonably foreseeable future action in the project area that would increase the risk of roadside fire ignition. This would expose soils to thermal extremes and limit infiltration rates, as described under *Nature and Type of Effects*.

The natural spread of invasive annual grasses and noxious weeds, combined with natural and human-caused fires, would continue to reduce native vegetation cover. Soils and biological soil crusts would become less stable and more susceptible to erosion.

All action alternatives would provide a regional approach for future fuels reduction and rangeland restoration management. Wildfire would continue to burn throughout the project area; however, fuels reduction would change wildfire movement and lengthen wildfire return intervals. Additionally, native vegetation restoration would establish more resistant and resilient communities. The treatment areas in each of the action alternatives could include overlap of treatments from other past, present, and reasonably foreseeable vegetation management projects. This would result in additive effects of soil compaction and the breaking of biological soil crusts. Over time, restoration would reduce soil erosion potential, and increase soil aggregate stability and water infiltration. Therefore, future projects approved under this PEIS would eventually increase ecosystem resistance and resilience on Great Basin rangelands.

Alternatives B and C would potentially affect the largest acreage of highly erosive soils, with 44,000 and 32,000 acres of highly erosive soils, respectively (**Table 4-2**), in the potential treatment areas. They would result in a greater contribution to cumulative impacts on soils in the short term than Alternative D and would also have the highest potential to disturb biological soil crusts through manual and mechanical treatments. Due to the restriction of restoration treatment methods under Alternative C, it may not provide enough treatment methods to improve current rangeland conditions. However, when combined with other present and reasonably foreseeable fuels restoration, fuel breaks, and vegetation management projects, such as the Tri-State Fuel Breaks Project (see **Table 4-1**), the additive effect of reduced invasive vegetation would help reduce the soil erosion potential where these projects overlap.

Alternatives B and D would provide a full range of potential treatment methods (**Tables 2-1 and 2-3**), but Alternative D is unlikely to include treatment of the Phase III Pinyon-Juniper vegetation state and would potentially treat the least number of acres. Consequently, the cumulative contribution of surface disturbance in conjunction with human development, livestock grazing, vegetation removal, and fuel breaks projects would be greatest under Alternative B.

In the long term, the use of multiple methods and tools for restoration treatments under Alternatives B and D would be more effective than Alternative C at lengthening fire return intervals and reducing the spread of invasive and noxious annual vegetation, while minimizing impacts on soil resources by implementing the design features listed in **Appendix D**. Alternative B would provide the BLM with the most flexibility for utilization of tools which would improve opportunities to use appropriate treatments based on vegetation states. However, this does not necessarily guarantee success of the chosen treatments (see **Section 2.4.2**).

The BLM's reasonably foreseeable PEIS for Fuel Breaks in the Great Basin, in combination with the treatments proposed under this PEIS, would have a synergistic cumulative effect that would be most pronounced under Alternatives B and D. Fuels reduction and rangeland restoration would establish resistant and resilient sagebrush communities; fuel breaks would help to protect these communities by increasing the opportunities to manage wildfires. Together, these factors would improve the biological, physical, and chemical properties of soils and biological soil crusts and decrease the potential for erosion in the long term.

4.7 Wildlife and Special Status Wildlife

Effects on wildlife from restoration projects would occur during project implementation and expected residual effects on wildlife are based on habitat alterations from treatments meeting objectives and goals. Goals for treatments include improving resistance to invasive annual grasses and resilience to disturbances such as wildland fire. Additionally, fuels reduction and rangeland restoration treatments would restore natural burn patterns and improve long-term ecosystem function, viability, and durability. In general, achieving these goals would affect wildlife by improving biological and structural diversity of habitat, which results from moving habitat in the direction of desired conditions and would depend on the scale and proximity of treatments in relation to wildlife habitat.

4.7.1 Assumptions

- Design features such as seasonal and spatial restrictions would limit direct and indirect impacts on some species, including special status wildlife.
- Impacts on wildlife habitat are directly related to changes within sagebrush, pinyon-juniper, and grassland habitats. Special status species were grouped by habitat association into the following groups: sagebrush-dependent species, grassland-dependent species, and pinyon-juniper-dependent species. See **Appendix J**, Special Status Species in the Project Area for a crosswalk of species and their habitat associations.
- Vegetation states reflect habitat conditions and the extent to which habitat for certain wildlife species is suitable.
- Different tools would be used to meet desired conditions, based on current conditions.
- Treatment levels and locations would be selected to ensure changes in habitat are not too abrupt for adaptation by local wildlife populations, and remaining habitat would be consistent with or moving toward desired future conditions (based on the natural fire return interval).
- Treatment areas would move toward desired conditions more quickly where more treatment types are available, since some treatment types may be more effective than others in specific site conditions.
- The length of time needed to reach desired conditions would depend on site-specific conditions.
- Aquatic habitat would be avoided; consequently, direct or indirect impacts to aquatic species would be unlikely.
- Effects of wildfire on wildlife are related to wildfire trends and fuel models as described under **Section 3.2**, Fire and Fuels.
- Reduced pinyon-juniper expansion would benefit most general and special status wildlife species associated with sagebrush communities.
- While acreage calculations are based on potential treatment areas for each alternative, indirect impacts on wildlife and special status species may occur outside these areas.
- Restoration success may require a combination of treatments over time.
- Long-term monitoring would occur to ensure original restoration objectives are maintained and corrective actions are taken before the integrity of the original project is degraded or lost.

4.7.2 Nature and Type of Effects

Effects from Fuels Reduction and Rangeland Restoration Projects

Restoration projects would have direct effects on wildlife, including special status wildlife species, during treatment implementation. Individuals or populations occupying treatment areas could be disturbed by equipment, vehicles, and human presence. Disturbances could result in behavioral changes such as habitat avoidance or flight response. Some wildlife, such as burrowing insects, small mammals, reptiles, or ground-nesting birds, could be injured or killed by treatments if they are unable to leave treatment areas quickly enough to avoid impacts. Direct impacts related to disturbance would be temporary, limited to the period of project implementation and maintenance. Direct impacts from the use of treatment tools are described in further detail below.

The Biological Assessment (BA) contains detailed analysis for all threatened, endangered, proposed, or candidate species that would potentially be affected by the proposed action. Species proposed for listing under the ESA and non-essential experimental populations whose continued existence is not likely to be jeopardized by the proposed action were excluded from detailed analysis. Proposed critical habitats that are not likely to be adversely modified by the proposed action were also excluded. Adhering to conservation measures identified in the BA would avoid or reduce impacts to ESA-listed species (see **Appendix D.2** in this PEIS). Design Feature 35 would ensure that the BLM implements restrictions and conservation strategies for special status species, including federally listed, proposed, candidate, and BLM sensitive species, as contained in approved recovery and conservation plans, cooperative agreements, and other BLM-adopted instruments.

Indirect impacts on wildlife from treatments would occur through effects on habitat conditions and would depend on initial vegetation and residual vegetation after treatment. See **Section 4.2**, Vegetation for detailed information regarding impacts on vegetation. Treatments would focus on moving current conditions toward desired conditions characterized by vegetation states that provide habitat diversity, resistance, and resilience. Changes would occur incrementally over time, and intermediate vegetation states and impacts would occur along the way to achieving desired conditions.

Vegetation removal could cause habitat fragmentation, particularly before replanted or reseeded vegetation becomes established. This could limit the movement or migration of some wildlife species, which prefer to stay hidden under the cover of vegetation and which require larger patches of shrubs (Hanser and Huntly 2006). Pygmy rabbits and greater sage-grouse, for example, generally rely on relatively large and contiguous areas of habitat to support home ranges and/or migration routes (Pierce et al. 2011; Wisdom et al 2011; Shinneman et al. 2018). Fragmentation may influence distributions of passerines such as Brewer's sparrows (*Spizella breweri*), sage sparrows (*Amphispiza belli*), and sage thrashers (*Oreoscoptes montanus*) (Knick and Rotenberry 2002, and is correlated with abandonment of sage-grouse leks (Wisdom et al, 2011). However, not all species would be sensitive to gaps in shrub cover or unvegetated areas and those that are limited are not expected to be numerous since they are already adapted to habitat types that typically have intermediate disturbance frequencies (which also create shrub-depleted areas). The magnitude of the gap in cover would depend on the treatment area size, pre-treatment vegetation, and treatment methods.

Restoration treatments in areas dominated by invasive annual grasses would reduce continuous fuel loading, thereby reducing the risk of wildfire spread and habitat loss in adjacent habitats over the long term. Treatments that target areas dominated by invasive annual grasses could temporarily create areas having very little residual cover. This would reduce the availability of habitat features such as cover, forage, and food sources for the few wildlife and special status species that utilize degraded habitats. For example, it could temporarily reduce food sources for pollinators that obtain pollen and nectar from exotic plants. Wildlife that utilize disturbed areas would temporarily have increased habitat.However, movement towards overall desired conditions with increased cover of perennial grasses and forbs would improve habitat conditions for most wildlife species by increasing habitat diversity and understory structure. Sagebrush-dependent species, such as pygmy rabbits (*Brachylagus idahoensis*), would benefit from an increase in habitat and habitat features that would result from the anticipated increase in the resistance and resilience of vegetation. Although these changes may gradually reduce the amount of habitat available for grassland specialists, such as western meadowlark and vesper sparrow, grassland species would ultimately experience beneficial impacts due to increased habitat quality resulting from reduced potential for invasive annual grass invasions.

Increased structural diversity from shrub planting in perennial and/or annual grass-dominated sites would improve habitat conditions for sagebrush-dependent wildlife by increasing the availability of features used for nesting and shelter. Interplanting would improve understory structure and diversity for grassland species initially. Over time, moving habitat toward the overall desired condition (a mosaic of Perennial Grasses, Forbs, and Shrubs and Perennial Grasses and Forbs) would reduce habitat availability for grassland species in some areas but maintain or increase it in others. Since the amount of grassland currently on the landscape exceeds presettlement conditions, reducing grassland would help return the landscape to historic conditions.

Treatments in areas having existing shrub cover (e.g., Invasive Annual Grasses and Shrubs, Shrubs with Depleted Understory) would initially reduce cover and structural diversity for sagebrush species. The degree to which the treatments would affect these species depends on the treatment method selected, treatment timing, and the level of shrub removal. Treatments that remove higher levels of shrub cover would reduce habitat features to a greater extent than treatments that retain a greater level of residual shrub cover. Effects would be minimized by managing the scale of the project so that large areas are not cleared all at once and by using methods that do not remove all the shrubs. Since sagebrush in high resistant and resilient sites would be maintained (and in other sites depending on the alternative), habitat would still be available over the short term. Treatments would be designed to create a mosaic, so untreated shrub cover would remain available for wildlife. Impacts from shrub removal would be temporary because reseeding with perennial vegetation and planting seedlings would eventually restore, and ideally increase, cover and habitat diversity. The resulting vegetation states with decreased annual grass cover and/or increased shrub cover would provide improved habitat for grassland specialists and eventually for sagebrush specialists (when shrubs are included in seed mixes or are interplanted) that are intolerant of invasive annual grasses (e.g., pygmy rabbit, horned lizards).

Treatments in the Shrub with Depleted Understory vegetation state would create a mosaic of vegetation types across the treatment locations. Although some treatments would initially reduce cover and habitat features for sagebrush species, the long-term improvement in the understory and the increased resilience of the landscape as a whole would be beneficial for most sagebrush-dependent wildlife species. The desired condition would result in optimal levels of vegetation cover and diversity that could provide habitat for a wider range of wildlife species over the long term.

The removal of encroaching pinyon-juniper would increase habitat availability for wildlife species that primarily use grassland and sagebrush habitat types by increasing the continuity, availability, and functionality of these habitat types. Removing predator perches and nesting sites would benefit species such as greater sage-grouse that are vulnerable to avian predation (e.g., by raptors), while opening the understory would allow sagebrush and perennial grasses to grow. Habitat for species, such as the pinyon jay, that extensively use pinyon-juniper would be reduced, but some species likely would recolonize in other areas. Remaining pinyon-juniper areas may become temporarily overcrowded, and individuals preferring pinyon-juniper habitat would experience increased competition for food and habitat. However, pinyon jays may also occupy ponderosa pine woodlands, sagebrush, scrub oak, and chaparral in the absence of pinyon-juniper (Balda 2002), although they mainly nest in large areas of dense pinyon-juniper woodlands (Johnson et al. 2017). There are few pinyon-juniper specialists, and many wildlife species, such as coyote, fox, and big game, use both pinyon-juniper and sagebrush habitat or other woodlands. Therefore, it is expected that most species would not suffer from a slight reduction in pinyon-juniper vegetation, while many would benefit from increased sagebrush conditions and availability. A review of the effects of pinyon-juniper reduction on wildlife abundance found that 69 percent of animal species responses to woodland reduction were non-significant; however, some woodland-affiliated species, such as woodland birds and ungulates, showed reduced abundances in response to woodland reduction, particularly methods that remove all trees (Bombaci and Pejchar 2016).

Over the long term, diversified vegetation and an increase in native plant species resulting from seeding, interseeding, and interplanting would generally increase the availability and quality of wildlife habitat by providing habitat features for a greater diversity of wildlife and more areas suitable for foraging, nesting, and cover. This would also increase habitat availability for pollinators, which require pollen- and nectar-rich forage resources (Xerces Society 2017). Restored habitat would be more resilient to disturbances such as wildfire; this would reduce the potential for wildlife mortality and habitat loss due to wildfire and other disturbances. Ultimately, vegetation changes would alter habitat conditions for wildlife by providing a mosaic of successional stages on the landscape, which is considered beneficial to many wildlife species (Innes 2017). Specific effects of each treatment method on wildlife are described below.

Effects from Chemical Treatment Methods

An in-depth discussion of chemical treatment effects on wildlife is provided in the Vegetation Treatments using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Environmental Impact Statement (BLM 2007 pp. 4-101 to 4-118) and the 2016 Final PEIS for Vegetation Treatments Using Aminopyralid, Fluroxypyr, and Rimsulfuron on BLM Lands in 17 Western States (BLM 2016a pp. 4-54 to 4-60).

Possible adverse direct effects on wildlife include damage to vital organs, change in body weight, decreased reproductive success, increased susceptibility to predation, and mortality. Adverse indirect effects include reduced forage and habitat; decreased wildlife population densities within the first year following application as a result of limited reproduction; avoidance of treated areas for several years following treatment, and subsequent changes to territorial boundaries and breeding and nesting behaviors; and increased predation of small mammals due to loss of ground cover (USEPA 1998). Potential impacts of chemical treatments on wildlife would vary depending on the type of chemical treatment, vegetation being treated, time of application, and duration and mechanism of exposure. Potential impacts would be reduced through the implementation of Standard Operating Procedures described in those PEISs (BLM 2007 pp. 4-98 to 4-99; BLM 2016a pp. 4-52 to 4-53).

In general, wildlife could be exposed to chemicals directly through contact with spray or indirectly through contact with foliage or ingestion of contaminated food items after direct spray. For most terrestrial wildlife species, the risk of exposure would be generally low or nonexistent. Species that primarily consume grass would have a relatively greater risk for adverse effects than animals foraging on other vegetative material because chemical treatment residue is higher on grass; however, harmful doses of chemical treatments are not likely unless the animal forages exclusively in the treatment area for an entire day (BLM 2007).

Indirect impacts of chemical treatments on pollinators are described under **Section 4.2,** Vegetation. Nonselective chemical treatments would reduce cover by preventing growth of all types of vegetation, reducing the quality of habitat, until seedings are established. Broadleaf chemical treatments that target shrubs would reduce shrub cover and increase current herbaceous cover, including perennial grasses and native annual forbs. Visual and audible disturbance to wildlife associated with human activity would occur during chemical treatment and would be similar to those described for mechanical treatment methods below.

Effects from Manual Treatment Methods

The use of hand tools and hand-operated power tools to cut, clear, or prune herbaceous and woody species could potentially disturb wildlife associated with human presence and noise. Mortality would not be expected for mobile species. Mortality of less mobile wildlife species (such as insects, hibernating reptiles or hibernating small mammals) would be unlikely from manual methods because qualified personnel would avoid individuals during treatment activities. The impacts of manual methods would generally be of lower intensity and would occur over smaller areas relative to other methods; however, the use of chainsaws and plug-planting could affect larger areas through either reducing juniper encroachment or adding plant diversity to the landscape. Residual effects of manual treatments on wildlife through effects on habitat would be the same as those described under *Effects from Fuels Reduction and Rangeland Restoration Projects*.

Effects from Mechanical Treatment Methods

In addition to effects on wildlife and habitat described under *Effects from Fuels Reduction and Rangeland Restoration Projects*, mechanical treatments would have direct impacts on wildlife from soil compaction or disturbance (visual and audible) associated with the use of heavy machinery during treatments. Mechanical treatments, including the use of agricultural mowers, masticators, and seedbed preparation equipment, could result directly in injury or death of small animals with limited mobility. Mechanized equipment could also disturb or destroy shallow burrows. Treatments that occur during hibernation periods may not affect animals if burrows are deep enough to avoid physical disruption. Vegetation removal could make small mammals and reptiles more vulnerable to predation due to a lack of protective hiding cover. While mechanical treatments would reduce standing live cover, they would leave residual downed wood/mulch, which may provide cover for small mammals and reptiles, though its functionality would likely differ from that of standing trees. The potential for harm to wildlife from mechanical treatments following burning is expected to be reduced as a result of the manifestation of prescribed fire treatment effects.

An agricultural mower could be used to reduce the height of herbaceous vegetation. Reducing the height and cover of the shrub canopy would impact wildlife species by reducing available hiding and thermal cover as well as reducing forage availability to species such as mule deer and jackrabbits. As described under the alternatives below, design features would ensure that vegetation would remain at sufficient levels to support wildlife. Migratory birds that nest within or under shrubs could lose nesting habitat depending how much shrub height and cover is reduced. Mowing or mastication could result in mortality for less mobile wildlife species.

Effects from Prescribed Fire

Wildlife are likely to temporarily avoid areas where prescribed fire is used due to the fire and associated human activity; however, impacts would be short term and have little effect on a majority of wildlife species, as prescribed fire would be primarily used either at a small scale within pinyon-juniper treatment areas for pile and jackpot burning or in areas with compromised habitats dominated by invasive annual grasses. Prescribed fire may cause localized mortality of less mobile wildlife species that are unable to vacate the area. Some species could avoid impacts by hiding in burrows, while others could flee. The level of impact would depend on the habitat quality of the area being burned as well as the type and scale of burning.

Creating a fireline as a component of prescribed fire would remove habitat for wildlife species because vegetation would be removed to bare mineral soil and to a width that would prevent embers from blowing or rolling across the line. The use of prescribed fire would be of low risk to surrounding habitat because burns would be contained within treatment areas to reduce or modify existing fuel loads or prepare the ground for seeding. After prescribed fire, follow-up treatments of chemical application and/or seeding would prevent invasive annual grasses from dominating treatment areas.

Effects from Targeted Grazing

Targeted grazing could directly affect less mobile wildlife species through trampling as well as from habitat alterations that result from consumption of or damage to vegetation. The presence of livestock could also cause temporary displacement of highly mobile wildlife. Fall and winter targeted grazing in crucial winter mule deer habitats where bitterbrush is present may have significant negative impacts on available forage. Most livestock classes will likely select for the more nutritious brush component rather than the cured-out grasses.

Targeted grazing may require temporary facilities for implementation, such as water haul sites, temporary fencing, and salt or mineral supplementation. Water and salt sites could attract big game species, whereas fences could create the potential for collisions by both big game as well as birds. The areas surrounding water and salt sites would be expected to have the most likelihood and highest magnitude for effects. Temporary fencing or following a graduated-use plan would minimize impacts on habitat outside the treatment footprint.

Residual vegetation after targeted grazing would have reduced foliar cover and increased litter. Depending on timing and species targeted, nontargeted vegetation may improve and species that rely on nontargeted vegetation may experience an improvement in their habitat.

Effects from Revegetation

Short-term impacts of revegetation treatments on wildlife would mainly come about from the use of tools necessary for seeding and planting. These effects are described under specific treatment methods above. Initially, vegetation removal for seedbed preparation would reduce the availability of habitat features such as cover, forage, food sources for pollinators, and nesting and perching sites, potentially leading to decreased habitat functionality and increased predation for resident populations. These impacts would be temporary because reseeding with perennial vegetation and planting seedlings would eventually restore, and ideally improve, habitat conditions.

Long-term impacts from revegetation treatments on wildlife would mainly consist of habitat modification. Revegetation would modify habitat conditions by increasing the cover of desired species and moving vegetation states toward the overall desired conditions. This would increase habitat features for some wildlife species but decrease habitat features for others. The magnitude of effects would depend on the alternative, project scale, current vegetative state, desired future conditions, and habitat needs of a particular species.

As described in **Section 4.2**, Vegetation, selection of plants for revegetation would be decided at the site level using BLM Handbook 1740-2. By adhering to guidelines in the handbook (see **Section 2.2.7** Native Plant Material Policy), the potential for impacts on wildlife such as competition or attraction of a different suite of pollinators would be low.

The BLM Instruction Memorandum IM 2016-013 directs the BLM to integrate pollinator friendly native plant species into restoration work (BLM 2015b). The increase in pollinator friendly native plant species would further increase the vegetation community's ability to support wildlife.

4.7.3 Effects from Alternative A

Under Alternative A, this PEIS would not provide regional programmatic analysis for future fuels reduction and rangeland restoration projects. Such projects would continue to be implemented throughout the project area on a site-specific basis. A lack of a regional analysis would cause a slower project planning process and would delay implementation as compared with a region-wide planning process. The trend of wildfire continuity, shorter fire return intervals, and departure from historic conditions would be expected to continue to some extent; alterations to current trends in the level and condition of wildlife habitat would be slow and patchy across the region.

General Wildlife

Large-scale restoration projects that occur outside of a region-wide fuels reduction and rangeland restoration program would generally reduce the loss of wildlife habitat to wildfire, while restoration projects would improve understory structure and habitat diversity for wildlife. Without a basin-wide approach, such projects would likely take longer to implement. Wildlife habitat alterations would not extend across the entire Great Basin and would not be as continuous due to lack of region-wide planning.

For these reasons, current trends in wildlife habitat conditions likely would continue. These include reduced resistance and resilience of sagebrush communities, which has resulted from invasion by invasive annual grasses and the encroachment of pinyon-juniper woodlands. Invasive grasses have contributed to the shortening of fire return intervals and increased wildfire continuity. These changes in wildfire regime have caused degradation and loss of sagebrush habitats and have altered and simplified plant communities, leading to increased homogeneity of landscapes (Balch et al. 2013; West 2000). ildfires will continue to occur at the current frequency and with similar continuity within the project area. Wildlife responses to repeated fires and habitat changes depend on the traits of the key species present (Bakker et al. 2011). In general, recurring wildfires could injure or kill various wildlife species and alter habitat by eliminating or severely reducing shrub cover and increasing the likelihood of the establishment of invasive annual grasslands (Brooks et al. 2015; D'Antonio and Vitousek 1992).

Loss of shrub cover and structural diversity would reduce or fragment wildlife populations that favor or are dependent on shrub habitats for breeding, nesting, hiding, thermal cover, and foraging. This would continue to shift wildlife assemblages toward increased abundance of grassland or generalist species and decreased overall biodiversity (Coates et al. 2016b). Data have shown that small mammal diversity and abundance are lower in recently burned or nonnative grassland sites relative to shrub-dominated sites (Klott et al. 2007).

Some species such as Brewer's sparrow, sagebrush sparrow, and sage thrasher would be capable of recolonizing smaller areas that recover in the absence of fire. Recovery of greater sage-grouse would take longer because they require large intact landscapes of sagebrush habitat, use higher densities of sagebrush for nesting, and exhibit high nest and breeding site fidelity (Connelly et al. 2004, 2011). Although greater sage-grouse may continue to use fire-affected habitat in the years immediately following wildfire, nest survival and adult female survival rates are typically reduced (Foster et al. 2018). Without improving the resistance and resilience of habitat across the project area to wildfire, there would be a reduced likelihood of the successful recovery of greater sage-grouse and other sagebrush obligates within the project area.

Grassland species, such as burrowing owls, short-eared owls, grasshopper sparrows, and long-billed curlews, could be directly affected by continuing wildfire trends due to increased habitat conversion to invasive annual grass-dominated sites and through loss of diversity of prey or forage species (Coates et al. 2016b; D'Antonio and Vitousek 1992). Grassland species would likely experience increased habitat availability in the years following fires due to an abundance of grassland habitats as grasses become reestablished; however, the potential for spread of invasive annual grasses that often results from opening of the shrub canopy (Davies et al. 2011) may reduce the quality of grassland habitat by reducing the structural diversity of the cover and the biological diversity of plant and insect forage species (Block et al. 2016; Coates et al. 2016b). Reptiles such as the desert horned lizards are generally vulnerable to invasions of annual grasses following wildfires because the high density of vegetation and lack of open spaces inhibits their movement (Hall et al. 2009; Newbold 2005).

Continuing wildfire trends could reduce the amount of intact pinyon-juniper habitat (especially within higher density encroachment areas), thereby reducing habitat functionality for species that use pinyon-juniper features for nesting, roosting, forage, and cover. Uncontrolled wildfires that consume large areas of pinyon-juniper habitat have already reduced habitat availability for pinyon jays (Balda 2002), and this trend is expected to continue. Some bat species, such as Yuma myotis, use a variety of habitats and may adapt to postfire conditions by expanding their distribution to areas outside the burn. Habitat loss could also reduce populations of small mammals such as red-tailed chipmunks.

Big Game

Big game species would experience habitat loss and modification due to continued encroachment of pinyon-juniper and altered wildfire regimes under Alternative A. Degradation and loss of sagebrush habitats would reduce forage and habitat conditions for big game, which primarily feed on forbs and browse (Watkins et al. 2007).

Habitat loss from fire and cheatgrass invasion has been identified as a main cause of reductions in mule deer populations in Nevada (Cox 2008). Although cheatgrass may provide fall and spring forage for mule deer, it does not provide thermal or hiding cover, or any forage while it is buried by snow. Recurring fire within and adjacent to the project area would continue to reduce the quality of mule deer habitat, particularly winter habitat, while unburned mule deer habitat within the project area could be degraded by increased levels of use by mule deer. Effects of existing habitat trends would be similar for elk, pronghorn, and bighorn sheep; however, these species are less dependent on shrublands for forage and cover than mule deer.

Migratory Birds

Migratory birds that prefer or require sagebrush (or other shrubs), grasslands, or pinyon-juniper would also experience continued habitat loss from potential wildfires and would modify their home ranges or seasonal use areas based on habitat availability and quality. Continued wildfire regimes and loss of shrubland habitat would result in an increased distribution and abundance of grassland bird species within the project area, especially those that can use disturbed areas and exotic herbaceous habitat types. However, habitat quality may be reduced by the potential for spread of invasive annual grasses (Davies et al. 2011). Repeated fire events across the shrub–steppe landscape generally lead to reduced habitat diversity, resulting in reduced bird species diversity (Paige and Ritter 1999). Frequent wildfires would reduce pinyon-juniper habitat especially within higher density encroachment areas, which are at greater risk of burning, thereby reducing habitat functionality for migratory species that use pinyon-juniper features for nesting, roosting, forage, and cover.

Continued wildfires and the loss of sagebrush habitat in some areas could negatively affect golden eagles due to the potential for continued loss of shrubland and a subsequent decrease in their main prey, black-tailed jackrabbits, whose populations are closely correlated with sagebrush cover (Kochert et al. 2012; Sands et al. 1999). Likewise, potential reductions in shrubland would limit prey for bald eagles, which opportunistically feed on various mammals (NatureServe 2018). Fast-moving wildfires could reduce potential nesting sites such as tall trees, foraging features, and resting/preening perches for eagles. Other special status raptor species that use shrubland habitat, such as ferruginous hawks, would be similarly affected.

4.7.4 Effects from Alternative B

The following tables show the acres of habitat types considered for potential restoration treatments by alternative (**Table 4-3**) as well as greater sage-grouse (**Tables 4-4** and **4-5**) and big game (**Table 4-6** and **4-7**) habitat acres and conditions considered for potential restoration treatments by alternative. Acres for all alternatives are shown together to facilitate comparison. The remainder of this section describes impacts from Alternative B.

Table 4-3
Acres of Habitat Types Considered for Potential Restoration Treatments by Alternative

Habitat Type[1]	Alternative B (Acres)	Alternative C (Acres)	Alternative D (Acres)
Grassland	5,356,364	5,168,724	972,936
Pinyon–Juniper	3,088,468	1,781,294	614,079
Sagebrush	20,116,475	8,670,766	4,336,698

[1]Habitat types may overlap and are not additive
Source: BLM GIS 2018

Table 4-4
Acres of Greater Sage-Grouse Habitat Types Within Grasslands and Shrublands Available for Potential Restoration Treatments by Alternative

Alternative	Habitat Type	Grasslands				Shrublands					Total
		Invasive Annual Grasses	Perennial Grasses, Forb, and Invasive Annual Grasses	Perennial Grasses and Forbs	Total Grassland	Invasive Annual Grasses and Shrubs	Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses, Forbs, and Shrubs	Shrub with Depleted Understory	Total Shrubland	
B	GHMA[1]	367,000	869,000	219,000	1,455,000	560,000	2,067,000	1,088,000	989,000	4,704,000	6,159,000
	IHMA[1,2]	27,000	203,000	126,000	356,000	58,000	750,000	579,000	28,000	1,415,000	1,771,000
	OHMA[1,3]	195,000	215,000	86,000	496,000	239,000	261,000	389,000	780,000	1669,000	2,165,000
	PHMA[1]	469,000	860,000	461,000	1,790,000	1,223,000	3,358,000	3,238,000	1,908,000	9,727,000	11,517,000
	Bi-State[4]	4,000	1,000	7,000	12,000	10,000	2,000	70,000	142,000	224,000	236,000
C	GHMA[1]	290,000	754,000	200,000	1,244,000	414,000	1,678,000	0	0	2,092,000	3,336,000
	IHMA[1,2]	20,000	165,000	108,000	293,000	39,000	424,000	0	0	463,000	756,000
	OHMA[1,3]	176,000	167,000	65,000	408,000	167,000	176,000	0	0	343,000	751,000
	PHMA[1]	360,000	649,000	344,000	1,353,000	818,000	1,998,000	0	0	2,816,000	4,169,000
	Bi-State[4]	2,000	0	4,000	6,000	4,000	1,000	0	0	5,000	11,000
D	GHMA[1]	17,000	94,000	34,000	145,000	27,000	151,000	152,000	75,000	405,000	550,000
	IHMA[1,2]	11,000	111,000	50,000	172,000	30,000	366,000	197,000	8,000	601,000	773,000
	OHMA[1,3]	3,000	7,000	5,000	15,000	6,000	11,000	20,000	15,000	52,000	67,000
	PHMA[1]	125,000	325,000	136,000	586,000	328,000	1,590,000	952,000	344,000	3,214,000	3,800,000
	Bi-State[4]	0	0	0	0	0	0	0	0	0	0

Source: BLM GIS 2018
[1]PHMA, GHMA, OHMA, and IHMA are not identified in Washington.
[2]ID only
[3]CA/NV only
[4]Habitat for the Bi-State greater sage-grouse population in California and Nevada.
Note: Pinyon-juniper acres may overlap with other vegetation states.

Table 4-5
Acres of Greater Sage-Grouse Habitat Types Within Pinyon-Juniper Areas Available for Potential Restoration Treatments by Alternative

Alternative	Habitat Type	Phase I	Phase II	Phase III
B	GHMA[1]	425,000	229,000	179,000
	IHMA[1,2]	579,000	96,000	7,000
	OHMA[1,3]	215,000	66,000	14,000
	PHMA[1]	781,000	219,000	78,000
	Bi-State[4]	52,000	23,000	10,000
C	GHMA[1]	269,000	0	0
	IHMA[1,2]	21,000	0	0
	OHMA[1,3]	143,000	0	0
	PHMA[1]	437,000	0	0
	Bi-State[4]	26,000	0	0
D	GHMA[1]	105,000	72,000	0
	IHMA[1,2]	64,000	11,000	0
	OHMA[1,3]	10,000	8,000	0
	PHMA[1]	344,000	143,000	0
	Bi-State[4]	0	0	0

Source: BLM GIS 2018
[1]PHMA, GHMA, OHMA, and IHMA are not identified in Washington.
[2]ID only
[3]CA/NV only
[4]Habitat for the Bi-State greater sage-grouse population in California and Nevada.
Note: Pinyon-juniper acres may overlap with other vegetation states.

Table 4-6
Acres and Condition of Big Game Grassland and Shrubland Habitat Considered for Potential Restoration Treatments by Alternative

Alternative	Habitat Type	Grasslands				Shrublands					Total[1]
		Invasive Annual Grasses	Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses and Forbs	Total Grassland	Invasive Annual Grasses and Shrubs	Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses	Perennial Grasses, Forbs, and Shrubs	Shrub with Depleted Under-story	Total Shrubland	
B	*All Habitat*										
	Bighorn Sheep	105,000	213,000	76,000	394,000	255,000	878,000	516,000	262,000	1,911,000	2,305,000
	Elk	408,000	825,000	560,000	1,793,000	767,000	3,415,000	4,102,000	1,825,000	10,109,000	11,902,000
	Pronghorn	1,268,000	2,197,000	923,000	4,388,000	1,969,000	4,650,000	4,002,000	3,760,000	14,381,000	18,769,000
	Mule Deer	843,000	1,106,000	634,000	2,583,000	1,589,000	2,346,000	3,690,000	3,338,000	10,963,000	13,546,000
	Crucial Winter Range										
	Bighorn Sheep	0	0	0	0	0	0	0	1,000	1,000	1,000
	Pronghorn	68,000	93,000	46,000	207,000	77,000	62,000	57,000	152,000	348,000	555,000
	Mule Deer	133,000	138,000	63,000	334,000	234,000	269,000	418,000	437,000	1,358,000	1,692,000
C	*All Habitat,*										
	Bighorn Sheep	94,000	168,000	68,000	330,000	200,000	590,000	0	0	790,000	1,120,000
	Elk	313,000	674,000	432,000	1,419,000	509,000	1,963,000	0	0	2,472,000	3,891,000
	Pronghorn	1,193,000	1,871,000	818,000	3,882,000	1,438,000	3,032,000	0	0	4,470,000	8,352,000
	Mule Deer	696,000	866,000	483,000	2,045,000	1,132,000	1,568,000	0	0	2,700,000	4,745,000
	Crucial Winter Range										
	Bighorn Sheep	0	0	0	0	0	0	0	0	1,000	1,000
	Pronghorn	57,000	79,000	34,000	170,000	58,000	53,000	0	0	111,000	281,000
	Mule Deer	105,000	108,000	48,000	261,000	166,000	198,000	0	0	364,000	625,000
D	*All Habitat*										
	Bighorn Sheep	14,000	27,000	16,000	57,000	40,000	238,000	124,000	16,000	418,000	475,000
	Elk	58,000	211,000	125,000	394,000	151,000	1,158,000	888,000	256,000	2,453,000	2,847,000
	Pronghorn	145,000	503,000	215,000	863,000	297,000	1,379,000	850,000	410,000	2,936,000	3,799,000
	Mule Deer	166,000	588,000	232,000	986,000	405,000	2,250,000	1,550,000	392,000	4,597,000	5,583,000
	Crucial Winter Range										
	Bighorn Sheep	0	0	0	0	0	0	0	0	0	0
	Pronghorn	12,000	35,000	6,000	53,000	12,000	14000	7,000	11,000	44,000	97,000
	Mule Deer	22,000	32,000	10,000	64,000	38,000	94,000	86,000	30,000	248,000	519,000

Source: BLM GIS 2018

Note: Pinyon-juniper acres may overlap with other vegetation states.

Table 4-7
Acres and Condition of Big Game Pinyon-Juniper Habitat Considered for Potential Restoration Treatments by Alternative

Alternative	Habitat Type	Phase I	Phase II	Phase III
B	*All Habitat*			
	Bighorn Sheep	183,000	73,000	33,000
	Elk	1,081,000	813,000	532,000
	Pronghorn	1,089,000	399,000	146,000
	Mule Deer	1,245,000	944,000	626,000
	Crucial Winter Range			
	Bighorn Sheep	0	0	0
	Pronghorn	41,000	11,000	5,000
	Mule Deer	220,000	208,000	144,000
C	All Habitat			
	Bighorn Sheep	123,000	0	0
	Elk	612,000	0	0
	Pronghorn	679,000	0	0
	Mule Deer	816,000	0	0
	Crucial Winter Range			
	Bighorn Sheep	0	0	0
	Pronghorn	28,000	0	0
	Mule Deer	160,000	0	0
D	*All Habitat*			
	Bighorn Sheep	52,000	6,000	0
	Elk	313,000	228,000	0
	Pronghorn	313,000	118,000	0
	Mule Deer	583,000	317,000	0
	Crucial Winter Range			
	Bighorn Sheep	0	0	0
	Pronghorn	10,000	3,000	0
	Mule Deer	33,000	24,000	0

Source: BLM GIS 2018
Note: Pinyon-juniper acres may overlap with other vegetation states.

General Wildlife

Under Alternative B, species associated with grassland, pinyon-juniper, and sagebrush habitat types would experience direct and indirect impacts from the use of all treatment methods (manual, mechanical, chemical, targeted grazing, prescribed fire, and revegetation) as described under *Nature and Type of Effects*. The acres of general habitat types and sagebrush habitat types available for potential treatments are shown in **Tables 4-3, 4-4,** and **4-5**, but most treatments and impacts would occur in the Alternative B emphasis area (see **Section 2.4.2**). Treatment levels would vary among vegetation types and locations and would follow habitat-specific design features to ensure wildlife and special status species populations with treatment sensitivity experience only gradual change (Design Feature 48 in **Appendix D**). This would also ensure that treatment efforts and residual habitat (within and adjacent to treatments) continue to provide habitat for adversely affected species.

Over the short term, the use of all treatment methods and habitat changes due to transitions towards overall desired conditions would lead to the full range of potential effects described under *Nature and Type of Effects*. The specific tools that would be used in existing vegetation states and temporary vegetation changes from conversion to desired conditions are described under **Section 4.2**, Vegetation.

Surface disturbance from the use of tools that clear large areas of land (e.g., chemical or prescribed fire treatments) would put habitat at risk of invasive annual grass invasions, which may reduce habitat quality for wildlife species. Following invasive plant management guidelines (Design Features 18-22 in **Appendix D**) would reduce this risk. The flexibility in treatment types would improve opportunities to use appropriate treatment methods based on vegetation states, but it would not necessarily guarantee success. In cases where it increases the likelihood for desired conditions to be achieved more quickly, it could mean fewer direct effects from re-treatment and fewer impacts overall.

Pinyon-juniper removal in all pinyon-juniper phases and revegetation in Phases II and III Pinyon-Juniper would likely increase habitat availability and features for sagebrush and grassland species (Donnelly et al. 2017). Removing encroaching pinyon-juniper trees would reduce habitat features such as nesting sites and cover for species that extensively use pinyon-juniper. Treatment design and the overall level of treatment of pinyon-juniper within the project area would consider the needs of both sagebrush and pinyon-juniper wildlife. Areas of old-growth pinyon-juniper and stringers or clusters of trees would be retained as habitat for pinyon-juniper species outside of sage-grouse habitat. Within sage-grouse habitat, generally no stringers or clumps would be left unless local data indicates they would benefit mule deer without impacting local sage-grouse populations. Reducing encroaching pinyon-juniper would lead to a more resistant and resilient plant community, which may lower the potential for future crown fires and associated habitat loss to wildfire.

Design features would reduce or avoid the effects of implementation activities on wildlife species by avoiding sensitive periods or high-value habitats (Design Features 1, 2, 34-47 in **Appendix D**). Design features would also consider the needs of wildlife species and temper the scale of treatments to maintain their habitat needs (Design Feature 48 in **Appendix D**). Additional design features related to targeted grazing, prescribed fire, and chemical treatments would reduce impacts on wildlife (Design Features 9-14, 15-18, and 49 in **Appendix D**).

Since sagebrush treatments under this alternative would be used to restore degraded understories, the residual habitat is expected to improve in the long term for sagebrush-dependent species. Thinning of these areas would maintain habitat availability for sagebrush obligates, and design features would prevent significant habitat modification in greater sage-grouse habitats (Design Features 37 and 38 in **Appendix D**). This would reduce the chance of impacts on sage-grouse and other sagebrush-dependent special status wildlife species. In addition to adhering design features in this PEIS, all project activities proposed for the Bi-State distinct population segment (DPS) would be in accordance with the Nevada California Greater Sage-Grouse Distinct Population Segment Land Use Plan Amendment (LUPA) and Record of Decision (ROD) (BLM 2016b). This document identifies goals, objectives, actions, and best management practices specifically designed to conserve, enhance, or restore habitats to provide for the long-term viability of the Bi-State DPS. Adhering to these features would reduce potential impacts from project activities (BLM 2016b; Tables ROD-1, ROD-2, and ROD-3, pp. 9–15). Long-term restoration of sagebrush habitats and reduction of fuel loads would be in accordance with goals and objectives for the Bi-State DPS and its habitat as identified in the 2016 ROD/LUPA (BLM 2016b). Treatments that occur in the California portion of the Bi-state population's range would adhere to the design features and protections included in the Bishop RMP (BLM 1993); this would ensure potentially adverse treatment effects on this population are minimized and beneficial effects are maximized. No documented leks or proposed critical habitat for the Bi-State DPS occurs within land managed by the Ridgecrest Field Office.

As habitat eventually reaches the overall desired vegetation state, it would become more resistant and resilient. Habitat changes would occur in high-priority sagebrush habitats (i.e., FIAT areas) and around these areas, thereby providing a buffer that would protect high-quality wildlife habitats from disturbances such as wildfire and annual grass invasions.

Big Game

Impacts on big game species would occur from the use of all treatment methods; the types of impacts would be the same as those described under *Nature and Type of Effects*. The acres and condition of big game habitat and winter range that would be available to potential treatments are shown in **Tables 4-6** and **4-7**. The scale of treatments would maintain the habitat needs of big game species (Design Feature 41 in Appendix D).

In addition to the inclusion of all treatment methods, Alternative B would have the greatest potential distribution and level of treatment among alternatives. Restoring degraded big game habitat through the reestablishment of grasslands would increase forage for big game; 41, 75, 54, and 42 percent of the total Invasive Annual Grasses within bighorn, elk, pronghorn, and mule deer habitat would be within the potential treatment area, respectively (**Table 4-6**). Further, 38, 73, 58, and 42 percent of the total Invasive Annual Grasses and Shrubs in bighorn, elk pronghorn, and mule deer habitat would be within the treatment analysis area, respectively (**Table 4-6**). Increased resistance and resilience from invasive annual grass treatments within shrublands would indirectly benefit big game by reducing the potential for habitat loss to disturbances such as wildfire and invasive species spread. The reestablishment of shrubs through seeding or plug planting would locally provide increased browse availability on winter range (**Table 4-6**).

Although mature pinyon-juniper forests provide high-quality thermal and escape cover for big game such as mule deer, expansion of these forests into surrounding grass and sagebrush habitats reduces browse (Watkins et al. 2007). Therefore, thinning in Phase II and Phase III Pinyon-Juniper areas would improve habitat conditions for big game by increasing forage. The majority of Phase II and Phase III Pinyon-Juniper within pronghorn and mule deer crucial winter range on the project area would be considered for treatment (**Table 4-7**). Habitat features such as thermal and escape cover would remain, because old growth pinyon-juniper areas and known safe sites would be avoided and stringers of trees or small clusters would be left for big game cover outside of sage-grouse habitat. Additionally, clearing Phase I Pinyon-Juniper may reduce some hiding cover for big game species and would prevent expansion and progression into higher phases of encroachment. When selecting treatment areas, the BLM would also prioritize areas where treatment would achieve big game habitat objectives. Reducing encroaching pinyon-juniper would increase habitat resistance and resilience, which may lower the potential for future crown fires and associated habitat loss to wildfire. Revegetation in these areas would increase habitat availability and features for big game.

Shrub treatments would shift habitat features, such as cover and forage, from contiguous areas of high shrub cover to a mosaic that includes increased grass and forb cover, while retaining sufficient shrub cover for browsing and hiding from predators. Reducing continuous fuel loading in shrublands would reduce the potential for big game habitat loss to wildfire over the long term. Approximately 38, 73, 58, and 42 percent of Invasive Annual Grasses and Shrubs and 48, 68, 61, and 20 percent of Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses within bighorn, elk, pronghorn, and mule deer habitat on the project area would be within the potential treatment area (**Table 4-6**). Using prescribed fire to achieve this goal would have short-term impacts such as reduced forage. However, treatments in shrubland would be phased so that not all habitat is treated at once and areas with suitable browse remain available (Design Feature 41). Thinning of shrubs in Perennial Grasses, Forbs, and Shrubs and Shrub with Depleted Understory would increase browse availability over the long term. Close to or over 50 percent of each of these vegetation states within each big game species habitat would be considered for treatment.

Design features for big game species would set temporal restrictions on project activities (Design Feature 39 in **Appendix D**), limit total habitat reductions (Design Feature 41 in **Appendix D**), and minimize the risk of disease transmission to bighorn sheep, for example, by avoiding use of domestic sheep or goats for targeted grazing within 30 miles of bighorn sheep habitat (Design Features 15 and 40 in **Appendix D**).

Increasing native perennial grasses, forbs or shrubs in highly resistant and resilient sites would be included under Alternative B, subject to constraints in design features. However, direct impacts (e.g., noise and other disturbance) associated with treatments are less expected since these areas are mostly in conditions that would not require such treatment.

The use of nonnative plant materials for revegetation could expand successful treatment into highly degraded areas where native plants are unlikely to establish, provided conditions in BLM Handbook H-1740-2 (BLM 2008, p. 87) were met. This could increase forage and cover availability for grazing big game species and reduce the likelihood of fire expanding into higher quality habitats.

Over the long term, effects from restoration projects on big game under Alternative B would be the same as those described for general wildlife and include increased forage and improved habitat conditions. The use of the full suite of tools for treatments and flexibility in treatment locations under Alternative B would improve opportunities to use appropriate treatment methods, which may provide a broad opportunity to improve conditions for big game throughout the project area.

Migratory Birds

Impacts on migratory bird species, including raptors such as golden and bald eagles, from the use of all treatment methods would be the same as those described under *Nature and Type of Effects*. Migratory bird habitats that would be affected by treatments include sagebrush, pinyon-juniper, and grassland vegetation types; impacts on these habitat types are discussed under *General Wildlife and Special Status Wildlife*. Design features would reduce direct impacts on migratory birds by avoiding treatments during the peak of the local nesting season for priority migratory bird species (Design Feature 42 in **Appendix D**).

All treatments, including prescribed fire, would potentially reduce nesting sites in the short term and may force nest abandonment from early and/or late nesting migratory birds. Avoidance of peak nesting season is expected to protect most nesting migratory birds (Design Feature 42).

Locally, sagebrush cover may be reduced in some areas due to treatment. However, treatments affecting sagebrush cover will consider the needs of sagebrush obligates, and the long-term outcome across the project area is expected to result in more of the habitat suitable for sagebrush obligate migratory birds.

Clearing or thinning encroaching pinyon-juniper habitats could reduce nesting and perching sites for migratory birds that use pinyon-juniper, such as the gray flycatcher (*Empidonax wrightii*), but areas of old-growth pinyon-juniper and stringers or clusters of trees would be retained as habitat and some species may recolonize other areas (see General Wildlife). Seeding and planting would increase habitat availability and conditions of both sagebrush and grassland bird species by reducing annual grasses and increasing the herbaceous understory used for cover and nesting.

Reductions in shrubland habitat associated with treatments under Alternative B likely would not modify potential foraging and nesting habitat for eagles, other raptors, and migratory birds due to design features (e.g., Design Feature 42 in Appendix D) and provisions that leave areas with appropriate levels of the different habitat types to meet the needs of all species. Many raptors (e.g., bald eagles and golden eagles) can modify behavior and home ranges to cope with the loss of shrubland habitat if resources exist. Other design features as described under general wildlife would help reduce impacts to migratory birds as well.

Over the long term, effects from restoration projects on migratory birds under Alternative B would be similar to those described for general wildlife and include improved habitat conditions from a reduction in pinyon-juniper encroachment, longer fire return intervals, and greater habitat diversity. In one study, populations of birds declined in sagebrush communities with increasing dominance by pinyon-juniper woodlands (Knick et al. 2005). Sagebrush-obligate species were also less likely to occupy habitat following large-scale fires that resulted in large grassland expanses and isolated existing sagebrush patches (Knick et al. 2005). Therefore, reduced fire continuity and pinyon-juniper removal is expected to benefit migratory birds associated with sagebrush habitat. Similarly, populations of grassland birds are expected to increase as perennial vegetation components of grasslands expand in the landscape (Knick et al. 2005). Changes would potentially improve predation opportunities for raptors due to enhancement of prey species' habitats and potential increases in prey populations.

4.7.5 Effects from Alternative C

General Wildlife

Acres of each general habitat type considered for potential treatment under Alternative C are shown in **Table 4-3;** the acres of greater sage-grouse habitat types and condition within the potential treatment area are shown in **Tables 4-4** and **4-5**. The majority of impacts would occur in Alternative C emphasis area (**Section 2.4.3**). Designing projects to avoid treatment of native vegetation, especially sagebrush, would minimize impacts on most wildlife species as described under Alternative B. The types of direct impacts that could occur would be limited to those from manual and mechanical treatment methods as described under *Nature and Type of Effects*. Indirect effects from habitat changes due to transitions towards the overall desired condition are also described under *Nature and Type of Effects*. Changes in habitats from movement towards the desired condition and specific tools available for use in existing vegetation states are described under **Section 4.2**, Vegetation.

Because sagebrush would not be treated under this alternative, direct impacts on sagebrush-dependent wildlife would be limited to effects that occur from manual and mechanical treatments used to treat the understory around or in sagebrush areas. Approximately 50 percent of the vegetation states containing invasive annual grasses in sage-grouse habitat types on the project area would be within the potential treatment area (understory only). All Perennial Grasses, Forbs, and Shrubs and Shrub with Depleted Understory would remain as available habitat. This would allow understory treatment in areas with patchy or low shrub cover, while preserving the shrubs. Alterations to sagebrush habitat, such as thinning of overgrown sites, would be limited due to avoiding treating sagebrush and highly resistant and resilient sites; sagebrush-dependent species such as greater sage-grouse may not benefit from improved habitat conditions over the long-term. Treating the understory would improve habitat conditions for grassland-dependent species over the long term due to decreased availability of fine fuels and potential loss of grassland to wildfire. Planting would also increase habitat features such as forage and cover in grassland and sagebrush habitats.

Seeding with native species and control of annual invasive species would have beneficial impacts on grassland species by increasing native perennial plants, which provide the most palatable and reliable forage and cover for native wildlife species. Similar to Alternative B, removal of Phase I Pinyon-Juniper would increase the area of treeless sagebrush habitats and improve habitat quality for wildlife species that typically avoid areas having trees. It would also decrease the availability of habitat and habitat features for species that extensively use the Phase I Pinyon-Juniper habitat type. However, extensive Phase II and Phase III Pinyon-Juniper vegetation states would not be treated. These areas would remain as habitat for species that are closely associated with dense pinyon-juniper, such as pinyon jays (especially during nesting; Johnson et al. 2017) and would continue to provide lower quality habitat for grassland and some sagebrush species. Phase II and III Pinyon-Juniper would remain marginal or unsuitable habitat for sage-grouse. These areas would continue to be at risk of wildfire, which could potentially lead to habitat loss for all wildlife species.

Design features applicable to wildlife under Alternative C would be the same as those described for Alternative B, but only those features related to manual and mechanical treatments would be relevant (**Appendix D**). Additionally, prohibiting treatments in greater sage-grouse breeding habitat during the breeding season would avoid disturbance to nesting grouse and other sagebrush-dependent wildlife species (Design Feature 37 in **Appendix D**, which only applies under Alternative C). This would limit impacts to sage-grouse and other sagebrush species to a greater extent relative to other action alternatives, but may reduce treatment effectiveness.

Relative to Alternative A, treatments would be expected to alter wildlife habitat through reseeding degraded habitats, reducing Phase I Pinyon-Juniper, and increasing native shrubs and forbs through plug planting. The use of only manual and mechanical methods would limit surface disturbance, and the associated risk of invasive annual grass invasions into wildlife habitat. However, the limitations on tools available for treatments (e.g., lack of targeted grazing and herbicides) might limit the success of some types of treatments and lead to more impacts from follow-up treatments over the long term. Sagebrush cover would remain intact and continue to provide habitat to sagebrush specialists, but areas having poor understory or invasive annual grasses would remain vulnerable to the harmful effects of wildfire as described under Alternative A. Pinyon-juniper and grassland habitats would be made more resilient to some extent, and the quality of these habitat types would be expected to increase relative to Alternative A. However, the lack of treatments in Phase II and Phase III Pinyon-Juniper would mean wildlife habitat in these areas would remain at risk of wildfire due to high fuel loading.

Big Game

Impacts on big game species from the use of manual and mechanical treatment methods are described under *Nature and Type of Effects*. The acres and condition of big game habitats that would be considered for treatment are shown in **Table 4-6** and **4-7**.

Although sagebrush would not be treated under this alternative, herbaceous vegetation in areas with sagebrush would be treated; 30, 48, 42, and 30 percent of Invasive Annual Grasses and Shrubs and 33, 39m 40m and 13 percent of Shrubs, Perennial Grasses, Forbs, and Invasive Annual Grasses within bighorn, elk, pronghorn, and mule deer habitat in the project area would be within the potential treatment area (**Table 4-6**). Understory treatment in areas with patchy or low shrub cover would improve the understory and thus increase big game forage, while preserving shrub cover for use as thermal protection and hiding. Intact and overgrown shrublands would remain as thermal and hiding cover.

Restoring degraded habitat through the reestablishment of perennial vegetation within invasive annual grasslands would improve habitat for big game species; 37, 58, 51, and 35 percent of Invasive Annual Grasses and 38, 55, 57, and 20 percent of Perennial Grasses, Forbs, and Invasive Annual Grasses within bighorn, elk, pronghorn, and mule deer habitat on the project area would be within the potential treatment area (**Table 4-6**). The reestablishment of shrubs through plug planting and the indirect effect of lengthening the fire return interval on winter range would benefit most big game species, especially mule deer where it overlaps their crucial winter range.

Retention of Phase II and Phase III Pinyon-Juniper would maintain cover for big game species, particularly where these areas overlap crucial winter ranges (**Table 4-7**). However, because these vegetation states would not be treated, they would continue to be at higher risk of wildfire, which could potentially lead to habitat loss for big game. Treatment of Phase I Pinyon-Juniper may reduce some hiding cover for big game and would prevent expansion and progression into higher phases of encroachment. Approximately 26, 33, 35, and 20 percent of Phase I Pinyon-Juniper within total bighorn, elk, pronghorn, and mule deer habitat on the project area would be considered for treatment (**Table 4-7**).

Design features for big game species would be the same as described under Alternative B (Design Features 39-41 in **Appendix D**). Over the long term, effects from restoration projects on big game habitat under Alternative C would be similar to those described for general wildlife. While some improvement may result directly from treatment, the limitation on tools and locations could limit opportunities for appropriate restoration Treatments. In some cases, where optimal restoration methods are unavailable, it may result in the continuation of big game habitat being threatened by fire and invasive plans throughout the project area.

Migratory Birds

Impacts on migratory bird species, including raptors, from the use of manual and mechanical treatment methods are described under *Nature and Type of Effects*. Migratory bird habitats that would be affected by treatments include sagebrush (manual treatment methods only or mechanical treatments if sagebrush would not be disturbed), pinyon-juniper, and grassland vegetation types; impacts on these habitat types are discussed under *General Wildlife*. Because sagebrush would not be treated, removal of nest sites used by shrub-nesting birds would be limited. Alterations of habitats used by raptors and their prey would also be limited. The area around shrubs could be treated to improve the understory, which would increase structural and community diversity and provide habitat for a greater diversity of migratory bird species. Use of native species for reseeding would improve habitat conditions by reducing annual grasses and increasing the herbaceous understory used for cover and nesting, but the success of reseeding efforts would be limited given restrictions to methods for preparing the seedbed.

Design features for migratory birds would be the same as described under Alternative B (Design Feature 42 in **Appendix D**). Manual removal of pinyon-juniper in Phase I areas would potentially reduce nesting and perching sites for some species, such as gray flycatcher, while improving habitat for other species, such as Brewer's sparrow and green-tailed towhee (Holmes et al. 2017). Phase II and Phase III Pinyon-

Juniper would remain as habitat for migratory birds that prefer dense cover. Seeding and planting with native species would increase habitat availability and conditions of both sagebrush and grassland bird species. Habitat alterations would be limited by the availability of treatment methods and locations.

The long-term effects from restoration projects on migratory birds under Alternative C would be the same as those described for general wildlife.

4.7.6 Effects from Alternative D

General Wildlife

Under Alternative D, the area considered for potential treatment would be limited to FIAT planned treatment areas. The location of wildlife habitats considered for potential treatments would be concentrated to high-value habitat areas that are considered vulnerable to the threats of fire, invasive grasses, and pinyon-juniper encroachment (**Table 4-3**). All treatment methods would be considered for treatments, and the types of impacts that could occur from treatments and habitat alterations are described under *Nature and Type of Effects*. The acres of greater sage-grouse habitat types and condition considered for treatments are shown in **Tables 4-4** and **4-5.** The majority of impacts would occur in Alternative D emphasis area (**Section 2.4.4**). Changes in habitats from movement towards the desired condition and specific tools available for use in existing vegetation states are described under **Section 4.2**, Vegetation.

Vegetation states within the FIAT planned treatment areas would have the same impacts and desired conditions as described in Alternative B for these same areas, with the exception that treatments in Phase III Pinyon-Juniper would be unlikely. In adjacent untreated areas, the current threat of wildfire and further invasive annual grass invasion would remain and trends for grassland-dependent wildlife would continue, as described under Alternative A. If wildfires were to occur adjacent to treatment areas, habitat loss could occur within these areas as well as within FIAT areas, including high-value sagebrush habitat.

FIAT planned treatment areas are high priority treatment areas, and treatments in these areas are expected to benefit sage-grouse. However, the area available for potential treatment would not include habitat used by the Bi-State Greater sage-grouse; this species would not have regionally planned treatments such as removal of avian predator perches and increased habitat from shrub planting. The Bi-State population may, however, benefit from locally planned treatments (similar to Alternative A) in this area, independent of this PEIS.

Treatments in Phase I and Phase II Pinyon-Juniper would have the same impacts on pinyon-juniper-dependent species as described under Alternative B. Phase III Pinyon-Juniper treatment would be unlikely. Phase III Pinyon-Juniper outside of the FIAT planned treatment areas would continue to provide habitat to wildlife species that extensively use pinyon-juniper; habitat availability and conditions for sagebrush-dependent species would not improve in these areas. Design features applicable to wildlife under Alternative D would be the same as those described for Alternative B (**Appendix D**), including considering local wildlife population needs for all habitat types (Design Feature 48 in **Appendix D**).

Relative to Alternative A, treatments under Alternative D are expected to concentrate the impact on wildlife habitat within high-value habitats, where they would reduce Phase I and Phase II Pinyon-Juniper encroachment and cover of annual invasive grasses and allow the landscape to return to more historic conditions. Initially, impacts would only extend to treatment areas (i.e., FIAT planned treatment areas for conservation and restoration). Over time, landscape-scale habitat alterations would occur. Increased resistance and resilience in FIAT planned treatment areas may alter fire continuity and ultimately provide a mosaic of habitat conditions that wildlife may use for different needs, such as forage or cover. Increased resistance to invasive annual grasses and resilience to disturbance is expected to increase the amount of high-quality wildlife habitat by restoring grassland and shrubland habitats. However, by not treating the relatively large degraded areas with low resistance and resilience outside of FIAT planned treatment areas, high-value wildlife habitat within the planned treatment areas may be at greater threat of loss or alterations over time due to invasive grasses and wildfires in adjacent untreated areas.

Big Game

Under Alternative D, the types of effects of treatments on big game would be the same as under Alternative B. The location of big game habitats and crucial winter range considered for potential treatments would be concentrated in high-value habitat areas that are considered vulnerable to the threats of fire, invasive annual grasses, and pinyon-juniper encroachment. The acres and condition of big game habitats that would be considered for treatment are shown in **Tables 4-6** and **4-7**.

Because only FIAT planned treatment areas would be considered for treatment, large areas of degraded grasslands exist outside of these areas would not be treated. This is reflected by the relatively low percentages of total grassland habitats (16, 16, 12, and 13 percent of total grasslands within total bighorn, elk, pronghorn, and mule deer grassland habitat in the project area) that are within the potential treatment area. The majority of grasslands would remain untreated, and forage quality for big game would not be altered in those areas.

Thinning Phase I and Phase II Pinyon-Juniper may reduce some hiding and thermal cover for big game species, but Phase III Pinyon-Juniper would not be treated and would continue to provide high-quality thermal and escape cover for big game species. Approximately 11, 17, 16, and 14 percent of Phase I Pinyon-Juniper and 4, 18, 16, and 15 percent of Phase II Pinyon-Juniper within total bighorn, elk, pronghorn, and mule deer pinyon-juniper habitats in the project area would be within the potential treatment area (**Table 4-7**). Ultimately, treatments in these areas would improve habitat conditions for big game by increasing forage and improving resistance and resilience in these areas. Similar to Alternative B, habitat features such as thermal and escape cover would remain in Phase I and Phase II Pinyon-Juniper because stringers of trees or small clusters would be left for big game. When selecting treatment areas, the BLM would also prioritize areas where treatment would achieve big game habitat objectives.

Design features to reduce impacts on big game species would be the same as described under Alternative B (Design Features 15 and 39-41 in **Appendix D**).

Over the long term, effects from restoration projects on big game under Alternative D would be the same as those described for general wildlife and include increased forage and improved habitat resistance and resilience. Impacts would apply to just the treatment area (FIAT planned treatment areas). High-quality sagebrush habitat used by big game in these areas may be at greater threat of loss or alterations over time due to disturbances such as wildfires in adjacent untreated areas.

Migratory Birds

Under Alternative D, the types of effects of the vegetation treatments on migratory birds, including raptors, would be the same as under Alternative B, except under Alternative D treatment of Phase III

Pinyon-Juniper would be unlikely. Treatments would be concentrated in high-value habitat areas that are considered vulnerable to the threats of fire, invasive annual grasses, and pinyon-juniper encroachment (**Table 4-3**). Loss of perching and nesting sites used by migratory birds that extensively use pinyon-juniper habitats would not occur in Phase III Pinyon-Juniper as these areas are unlikely be treated.

Design features to reduce impacts on migratory birds would be the same as those described under Alternative B. Over the long term, effects from restoration projects on migratory birds under Alternative D would be the same as those described for general wildlife. Impacts would apply to treatment areas (FIAT planned treatment areas). High-quality sagebrush habitat used by migratory birds in these areas may be at greater threat of loss or alterations over time due to disturbances such as wildfires in adjacent untreated areas.

4.7.7 Cumulative Effects

Cumulative Baseline

Actions that could cumulatively affect wildlife and wildlife habitat include human development, such as construction of roads and ROWs, mining and oil/gas development; conversion of wildlife habitat to cropland; livestock grazing; activities associated with fire and vegetation management plans; fuel break projects; other fuels reduction and rangeland restoration projects; noxious weed spread; and wildland fire.

Development within and encroachment on wildlife habitat, such as from minerals development and agricultural activities, urban development, and construction of ROWs and roads, have and will continue to affect wildlife throughout the project area through habitat modification, loss, and fragmentation as well as increased potential for injury or mortality. Approximately 21 percent of land in the western states, (including those covered in this PEIS but excluding Alaska), has been converted to intensive uses, such as urbanization, agriculture, and pastureland, which provide fewer benefits for wildlife than undisturbed habitats (Wright 2002 cited in BLM 2007). Although wildlife may find food and shelter in highly modified habitats, these habitats generally provide fewer habitat values and less structural complexity than unmodified areas, and therefore support fewer wildlife species and numbers (BLM 2007). Areas that have not been converted have still become fragmented and have undergone alterations that reduce their value to wildlife (USDA Forest Service and USDI BLM 2000 cited in BLM 2007). In the Interior Columbia Basin, which overlaps the project area, there has been an overall downward trend in habitat value from historical conditions for nearly all habitat types; species that use older forests, sagebrush, and grassland habitats have been most affected by loss and modification of habitat in the region, including various migratory birds species (USDA Forest Service and USDI BLM 2000 cited in BLM 2007).

As human population levels rise, the extent of urban areas is expected to further encroach on wildlife habitat. This will be the case especially on private lands, which are scattered throughout the project area, particularly in central Washington, northern Oregon, northern California, northern Utah, and southeastern Idaho (**Figure 1-1** in **Appendix A; Table 1-1**). Wildlife habitat, including areas with sagebrush, grassland, and pinyon-juniper, could be further reduced and fragmented; as this occurs, the importance of remaining habitat for supporting populations will increase. Increasing development and road use associated with higher population levels will increase the risk of injury or mortality of wildlife due to collisions with vehicles or structures.

Ongoing permitted livestock grazing and trailing occurs throughout most of the project area and is expected to continue. Effects of ongoing livestock grazing are expected to vary by wildlife species and the habitat quality within allotments. Species that use more open habitats are expected to benefit, while species that require taller vegetation (such as taller grasses) could be negatively affected by grazing in localized areas. Livestock could disturb, displace, or trample small, less mobile animals such as reptiles and ground-nesting birds although this is rare. Grazing can also alter wildlife habitat in localized areas by consuming or trampling vegetation used by wildlife for food and cover. Further, infrastructure may require removal of habitat and pose a threat of collision for some species. Current and future livestock use at permitted levels would not be expected to compete with the forage and cover requirements for wildlife because Standards for Rangeland Health and Guidelines for Livestock Grazing Management are intended to reduce these effects. In areas where livestock grazing is not managed to improve rangeland health, habitat degradation for wildlife may occur.

The effects of past, present, and reasonably foreseeable vegetation treatments such as invasive annual grass removal, vegetation planting and seeding, noxious weed treatments, fuel breaks, and postfire treatments on wildlife mainly consist of habitat alterations, but specific effects vary depending on the location, original vegetation community, and treatment methods. In cases where proposed or ongoing projects meet the objectives for those project areas, the treatment level or scale of this PEIS would be reduced because site-specific projects would not be necessary in these areas. For example, the Bruneau Owyhee Sage-grouse Habitat Project is underway and will treat up to 617,000 acres in southwestern Idaho to maintain and improve sagebrush steppe habitat. If habitat objectives are met, then a large area of habitat used by sagebrush- and grassland-dependent wildlife would not require pinyon-juniper treatments under this PEIS. See **Table 4-1** for other examples of past and ongoing vegetation management projects in the project area.

Vegetation projects can contribute to increased risk of injury or mortality of less mobile wildlife species while treatments are taking place. Large-scale pinyon-juniper removal projects reduce important features such as cover and nesting sites used by species like the pinyon jay, and these types of activities are increasing (NatureServe 2018). Shrub planting projects may help recover shrub communities more quickly relative to natural recruitment, which would improve habitat for most wildlife in the proposed project area. Where successful, restoration of native vegetation and increased plant diversity has and will continue to increase habitat availability and features such as cover and forage for wildlife throughout the project area. The accumulation of past, present, and reasonably foreseeable vegetation treatments across the cumulative effects analysis area is expected to improve the overall quality of wildlife habitat by decreasing risk of invasive species and increasing native species that provide forage and cover. However, treatment success is expected to be limited in areas that continue to experience repetitive wildfires.

Past, present, and reasonably foreseeable activities resulting from fire management plans and policies have and will continue to affect the condition and extent of wildlife habitat. Effects will vary based on the actual plan and location. In general, wildfire suppression protects wildlife and their habitats by reducing potential habitat loss, but it also leads to altered habitat conditions by increasing stand density, favoring shade-tolerant species, and promoting encroachment of trees into grasslands and shrublands. Encroaching shrubs and trees crowd out grasses and forbs used by wildlife for forage and cover, while invasive annual grasses provide little forage value or habitat structure for wildlife. Declines in big game winter range, density of nesting raptors, and nongame bird abundance have also been observed in cheatgrass-dominated areas (USDA Forest Service and USDI BLM 2000).

Fuel break projects that have and will continue to be implemented throughout the project area, including BLM's reasonably foreseeable PEIS for Fuel Breaks in the Great Basin, will help increase wildfire-fighting abilities and decrease the risk of wildfire spread and loss of wildlife habitat. The combined effects of fuel breaks and fuels reduction and rangeland restoration projects will protect wildlife and wildlife habitat and also help restore habitat to historic conditions, which might otherwise be altered from fire suppression.

Natural processes such as wildfire and the spread of invasive annual grasses impact wildlife through habitat loss and alterations (Balch et al. 2013; West 2000). Invasions of annual grasses reduce habitat quality and biological diversity (Coates et al. 2016b; D'Antonio and Vitousek 1992). Pinyon-juniper encroachment into grasslands and shrublands may increase cover and forage options for some wildlife species such as mule deer in the early stages (Gruell 1986; Austin 2000; Innes 2013), but overall forage is reduced in areas with later stages of encroachment. Pinyon-juniper encroachment also decreases habitat quality for sagebrush and grassland species. Sagebrush-dependent species that require high shrub density, such as the greater sage-grouse, are particularly vulnerable to continuous shrub cover decline due to natural processes such as wildfire and invasive annual grasses (Brooks et al. 2015; Coates et al. 2016b).

Under all action alternatives, treatments would add to increased risk of injury or mortality of species with limited mobility due to use of roads and tools over the short term. This effect would likely be greatest under Alternative B, which proposes the most acres of wildlife habitat types available for potential treatments and the most opportunities to use appropriate treatments based on vegetation states. Under Alternative C, the cumulative contribution to increased risk of injury or mortality would be limited because only manual and mechanical treatments would be used. However, more follow-up treatments may be required because treatments would take longer to achieve desired conditions. Under Alternative D, cumulative effects of increased risk of injury or mortality would be limited in extent. This is because the area of wildlife habitats that would be considered for potential treatments, and which may overlap other actions, would be limited to FIAT planned treatment areas. For all action alternatives, this effect would occur during project implementation for the lifespan of the PEIS, but the frequency and scale would likely decrease over time, as treatments begin to take effect and fewer and less-intense treatments are needed.

When combined with the baseline effects of human and natural activities that reduce or modify wildlife habitat, activities under all action alternatives would lessen the consequences of future habitat changes. This would come about by improving habitat resistance to invasive species spread and resilience to such disturbances as wildfire. This would not negate the effects of habitat reductions and alterations due to human land use, such as development, that are likely to continue in wildlife habitat; however, it would improve the ability of remaining habitat to support wildlife species. Alternative B would have the largest countervailing effect because it allows the most opportunities to use appropriate treatments based on vegetation states. The countervailing effect of Alternative C would be lower because restrictions on tools available for use would likely hinder the application and success of treatments; this would mean more habitat would be degraded from invasive species spread and pinyon-juniper encroachment. Additionally, sagebrush would not be treated, which would lead to a greater potential for loss of wildlife habitat due to wildfire and a greater need for emergency stabilization and rehabilitation. The countervailing effect of Alternative D would be limited to a smaller area because fewer acres of habitat would be considered for potential treatments; treatments would focus actions in areas determined to be priority for protecting relatively intact areas; however, high-value sagebrush habitat within the planned treatment areas may be at greater threat of loss or alterations over time due to invasive grasses and wildfires in adjacent untreated areas.

4.8 CULTURAL AND TRIBAL RESOURCES

4.8.1 Assumptions

- This analysis provides a broad overview of cultural resource types and potential effects, based on available information including the BLM's National Cultural Resources Information Database GIS layer (BLM Instruction Memorandum IM 2018-079). However, available inventory data for large dispersed areas are incomplete and past inventories may be geographically biased toward project-oriented undertakings (often along roads), thus additional archaeological surveys would be required in most cases.
- Identification of Tribal resources, including sacred sites, requires the expertise of traditional practitioners, elders, or others with specialized traditional knowledge. Potential impacts may be difficult or impossible to determine unless disclosed during Tribal consultation.
- Access to pinyon nut sources is a recognized concern among Native Americans. The objective of pinyon-juniper treatments is to remove encroaching pinyon-juniper in a manner consistent with Tribal treaty rights and other cultural resource laws and authorities. Project-specific consultations with federally recognized Tribes would be necessary to identify Native American traditional use areas and to consider project effects on cultural and economic values.
- Restoration projects may reduce the potential for fire-sensitive cultural resources to be lost during wildfires and wildfire suppression efforts, and promote long-term enhancement of natural resources important to Tribal cultures by changing vegetation conditions to a more desired state, improving ecosystem structure and function, and facilitate returning the length of the fire season closer to its historical duration. However, there may be a short-term loss of access and privacy during treatments.

4.8.2 Nature and Type of Effects

Effects from Restoration Projects

Under all action alternatives, undertakings involving restoration would continue to be subject to site-specific compliance with Section 106 of the NHPA including cultural resources inventories and Tribal consultation (See **Appendix D).** Such measures would help to minimize impacts to significant cultural resources under all action alternatives. Native American religious concerns and sacred sites would be further protected through compliance with EO 13007 (Indian Sacred Sites), The Religious Freedom Restoration act of 1993, and the American Indian Religious Freedom Act of 1978.

Cultural resource inventories, including background research, archaeological surveys, and consultation with state SHPOs and interested Tribes would be used to identify and protect significant archaeological sites, including Traditional Cultural Properties (Parker and King 1998), collectively known as "historic properties" as defined by the National Historic Preservation Act, Section 106 and regulations under 36 CFR Part 800. Consultations with groups such as cemetery societies, trail associations, or local cultural groups may also be necessary in some cases. Inventories and consultations would be appropriate to the scale and level of disturbance. Effects to significant cultural resources would be avoided or minimized through data recovery, recordation, monitoring, or other appropriate measures. Further site-specific research and consultation would be needed to determine whether Tribal treaty-or trust-based rights or other federal Tribal agreements are applicable and to identify potential impacts on Tribal interests as well as to determine means to avoid or minimize such impacts.

Damage, destruction, or movement of archaeological artifacts and site features may result in a loss of aspects of historic properties that may contribute to their eligibility to the NRHP, including the ability of the site to contribute information on important research questions such as site function, dates of use, subsistence practices, and environmental change. Archaeological resources that are not considered significant under the NRHP would usually not be identified for avoidance or mitigation, with the exception of resources like historic cemeteries or sacred sites that have other important cultural values outside of NRHP criteria.

Restoration projects and their associated maintenance can directly affect the physical and spatial integrity and visual setting of cultural resources. Indirect effects can result from erosion or temporarily increased visibility of archaeological resources due to vegetation removal, thus making them more susceptible to vandalism and illegal artifact collection. The potential for impacts would vary by treatment type, amount of disturbance, methods used, and local environmental conditions like soil type. Effects on the physical integrity of surface and near-surface archaeological sites could occur from all restoration treatments. Loss of physical integrity can be a permanent impact on nonrenewable cultural resources while impacts on setting may be temporary during treatment or permanent.

Avoiding historic properties during treatments may compromise the effectiveness of treatments in some circumstances; for example, by leaving a patch of untreated weeds that could act as a seed source. Avoiding sites during certain treatments can also cause effects such as from cattle congregating under trees remaining after tree removal in the surrounding area; islands of untreated vegetation signaling site presence to potential looters (Haas 1983); or erosion from lack of seeding of sparsely vegetated ground (Harmon 2011).

Changes to visual setting from the restoration projects could affect certain cultural resources, such as historic roads and trails, cultural landscapes, and Tribal resources such as sacred sites. Although temporary disruptions to visual setting are possible during treatments like vegetation removal, restoration would benefit the context and setting of resources when vegetation is returned to a more historic state. During treatments, there may be a temporary loss of access to Tribal resources, as well as decreased privacy and seclusion at culturally important sites. The BLM would minimize the temporary loss of access to culturally significant resources through consultation under all alternatives. Effects to wildlife, plants, and other aspects of the environment could be of concern to Tribes. Treatments could result in removal or chemical treatments of traditional plant resources, particularly if such resources are not identified for avoidance during Tribal consultation. Restoration of natural vegetation could benefit plant and animal communities that are important to Tribal heritage.

Restoration projects would reduce the risk of impacts from wildfire and suppression activities on archaeological and Tribal resources. Wildfire can cause a broad range of direct and indirect effects on cultural resources. A full discussion of these can be found in Ryan et al. (eds.), 2012. Use of fire as a treatment could directly affect or consume flammable cultural resource artifacts and features, cause spalling, cracking, and staining of ceramics and rock (either as a surface for rock art or as part of a feature or structure), and distort the analysis of an artifact's date and function. Some indirect effects could include post-fire erosion, carbon contamination in archaeological deposits from tree root burnout, disturbances from firekilled tree-fall on features, thermal shock and subsequent rock spalling from fire retardants, and vandalism/looting due to exposure. Prior to implementing treatments, resource concerns would be identified and addressed; reducing the risk of wildfire on resources from emergency wildfire suppression activities like fire breaks where identification and avoidance may be impossible. Reducing wildfire would particularly benefit fire-sensitive resources like wooden structures and rock art, as well as natural resources important to Tribes.

Effects from Manual Treatments

Because of the low potential for ground disturbance and the lack of heavy equipment use, manual treatments would have a very low potential to impact archaeological resources. In addition, resources not observed during archaeological inventories (such as small features obscured by vegetation) could be more easily discovered and avoided as the work progresses.

Effects from Mechanical Treatments

Depending on the specific tools and types of equipment used to remove plants and prepare seedbeds, mechanical techniques could cause surface and near-surface disturbance, including displacement of archaeological materials over short vertical and horizontal distances, artifact damage, or destruction of features. Repeated treatments in the same areas could have additive effects. Significant displacement of soils containing buried intact archaeological deposits could affect scientific values of sites. Buried archaeological deposits may not be detected during pre-work inventories unless there are surface exposures.

Treatments causing greater vertical and horizontal disturbance, such as disking and tilling where the entire surface would be disturbed to a depth of several centimeters, would have a greater potential for archaeological site disturbance than less intrusive treatments, like drill seeding where often only the first 3 centimeters of soil are disturbed within narrow and spaced margins. Drill seeding or harrowing where usually only narrow furrows are created would cause less surface disturbance than tilling and effects on lithic artifact scatters would be negligible in many cases, depending on soil texture and other site characteristics (Bryan et al. 2011, Halford et al. 2016). Some artifact types like ceramics, wood, or bone would be more easily damaged by crushing or compaction (Halford et al. 2016). Effects from chaining or imprinting would also be variable depending on vegetation, soil, and resource conditions. For example, chaining to remove live trees may have substantial impacts on archaeological site integrity due to the soil disturbance of uprooting that may reach three feet or more in depth (Gallager 1978, DeBloois et al. 1978). Chaining where standing dead trees are broken off rather than uprooted or where only shrubs and grass are present would result in less substantial effects. Mowing (McCormick and Halford 2003) and mastication would normally have little or no effect on site types like lithic artifact scatters aside from effects from the vehicles. Short-term tracked and rubber-tired vehicle use can have impacts ranging from compaction, displacement or soil loosening disturbance (Wood 1982) to more horizontal disturbance of several inches or more if soils are soft and/or wet or when tracked vehicles turn within a site (Foster-Curley and Horn 2008). Non-portable features such as rock cairns or wall remnants could be damaged if driven over during any type of treatments. Mechanical methods are less effective in avoiding previously undiscovered or undocumented resources than manual methods.

Effects from Prescribed Fire Treatments

Impacts from prescribed fire treatments could occur due to the loss of combustible artifacts and features to fire as well as damage through chemical and thermal alteration of bone, rock art, stone, and ceramic artifacts (see Ryan et al., eds. 2012). The physical or chemical characteristics of materials that have scientific information potential could be altered by heat and fire. Impacts could occur on Tribal resources, including loss of subsistence resources, visual impacts to nearby sacred sites, short-term loss of access, or intrusion of smoke during treatment.

Effects from Chemical Treatments

Chemical use could affect archaeological sites by altering or contaminating organic materials or by leaving traces on artifacts and features that might otherwise be used for scientific analysis; however, chemicals would have less potential for impacts than mechanical or manual treatments. This is because their use would eradicate invasive plants in archaeological sites without disturbing the ground. Chemical application could also limit the use of Tribal resources in the vicinity of treatments or result in chemical exposure (Ando et al. 2002). The duration of such impacts may be long term, especially in areas used for gathering plants for traditional cultural purposes, such as food, medicines, or basketmaking. Traditional users may be reluctant to gather in these areas for months or years after treatment.

Effects from Targeted Grazing Treatments

There would be minimal potential for surface and near-surface disturbance of cultural resources and loss of plant resources through livestock trampling and concentration. Grazing generally results in only minor surface disturbances with limited potential for direct effects on cultural resources. Past studies have demonstrated that grazing impacts on cultural resources are primarily of concern in areas of long term concentrated livestock use, such as around water sources and corrals (Roney 1977; Osborn et al. 1987).

4.8.3 Effects from Alternative A

Under Alternative A, there would be no programmatic analysis for restoration projects; however, large and small projects would continue to occur on a site-specific basis.

BLM undertakings involving restoration projects would continue to be subject to cultural resources review, compliance with Section 106 of the NHPA, consultation with Tribes, and consideration of Tribal interests. The potential for reducing the impacts and risks from wildfires and wildfire suppression on cultural resources would continue. However, projects would generally take longer to plan and implement, and thus the risk of wildfire and continued conversion of vegetation communities to invasive annual grasses would be more likely. Native plant communities would be less protected, and soils would be more likely to suffer erosion. There would be a greater potential for the subsequent loss of some tribally important plant and animal resources and erosion of archaeological sites.

4.8.4 Effects from Alternative B

As described in *Nature and Type of Effects*, manual and mechanical treatment and revegetation methods have the potential for surface and near-surface disturbance of archaeological sites. There are also potential impacts on cultural and Tribal resources associated with chemical treatments, targeted grazing, and prescribed fire. All these treatment methods would be allowed under Alternative B for fuels reduction or rangeland restoration, depending on the vegetation state.

The methods, tools, and acreage that could be treated under this alternative would result in an initial risk of direct impacts from treatments. The emphasis on protecting, conserving, and restoring sagebrush communities through manual, mechanical, prescribed fire, and revegetation treatments would lead to efforts to reduce the encroachment of pinyon-juniper into other areas and could conflict with Native American pinyon pine nut gathering. For comparison purposes, 4,392,000 acres of pinyon-juniper are identified within the potential treatment area for Alternative B; actual treatment locations would be selected based on site-specific conditions in consultation with federally recognized Tribes.

Alternative B would allow for greater flexibility in effectively locating and implementing appropriate treatments that may improve ecosystem structure and function. Lengthening the wildfire return interval and increasing restoration may be associated with an overall reduction in impacts from wildfires and suppression activities on cultural resources and the enhancement of native vegetation, habitat, and landscape use over the long term. There could be short-term increases in wind erosion resulting from treatments that disturb soils and remove vegetation; however, there likely could be long-term benefits to soil stability in restored areas that would protect many types of archaeological sites.

4.8.5 Effects from Alternative C

As described in *Nature and Type of Effects*, manual and mechanical treatment methods have some potential for surface and near-surface disturbance of archaeological sites. Limiting the types of treatments and excluding mechanical treatment of sagebrush would generally reduce the risk of ground-disturbing impacts on cultural resources. Limiting the types of treatments, excluding mechanical treatment of sagebrush, and not treating Phase II and III areas would generally reduce the risk of ground-disturbing impacts within those areas. However, excluding the use of chemicals could lead to more mechanical treatments, and thus a greater potential for resource impacts in other areas.

Treatment of pinyon-juniper areas would only occur in Phase I areas; no treatments would occur in Phase II and III areas, thus limiting potential impacts to culturally significant trees and potential effects from tree removal. For comparison purposes, 2,091,000 acres of pinyon-juniper are identified within the potential treatment area for Alternative C; actual treatment acres would be selected based on site-specific conditions. Using only manual treatments and conducting project-specific consultations for treatments in pinyon-juniper areas could facilitate maintaining Native American pinyon gathering while seeking to reach desired conditions for restoration projects.

The imposition of treatment limitations under Alternative C on treatments could constrain the beneficial effects on ecosystem structure and function. Achieving desired conditions for the different vegetation states from restoration projects could be slower, and less progress could be made in lengthening the wildfire return interval and returning the length of the fire season to its historical duration. In the long term, the potential for less frequent wildfire and improved ecosystem structure would reduce the risk from wildfires on fire-sensitive cultural resources and enhance degraded vegetation communities that may have cultural uses.

4.8.6 Effects from Alternative D

Alternative D would allow the use of all treatment methods. The potential for ground-disturbing and other impacts on cultural resources and their settings under Alternative D would be as described in *Nature and Type of Effects.* Alternative D would target previously defined priority emphasis areas for conservation and restoration areas for restoration projects. There would be few restrictions on vegetation types treated but more areas excluded from treatment than the other alternatives.

In pinyon-juniper areas, manual, mechanical, prescribed fire, and revegetation treatments would be allowed. For comparison purposes, 915,000 acres of pinyon-juniper are identified within the potential treatment area for Alternative D; actual treatment acres would be selected based on site-specific conditions. Alternative D would provide flexibility in treatments and improving ecosystem structure and function focusing on priority areas. Over the long term, lengthening the wildfire return interval and increasing restoration could be associated with an overall reduction in impacts from wildfires on fire-sensitive cultural resources and the enhancement of native vegetation, habitat, and landscape use.

4.8.7 Cumulative Effects

Cultural resources that may be directly or indirectly affected occur throughout the project area in a variety of environments. Because some types of cultural resources are nonrenewable, the effects on these resources can be permanent. BLM-authorized actions that could affect cultural resources would be subject to project and Section 106 compliance review, though effects to cultural resources cannot always be eliminated through mitigation or design features. BLM resource management plan allocations, as well as other federal, state, or local planning, protection, or process requirements, also reduce the potential for impacts on cultural and Tribal resources.

The past, present, and reasonably foreseeable actions in **Table 4-1** likely have affected and would continue to affect cultural and Tribal resources through direct and impacts effects from project undertakings on historic properties have been and would continue to be minimized through consultation with Tribes and compliance with the NHPA Section 106 process. These actions are fire suppression, fuel break construction, vegetation management, roads and utility ROWs, livestock grazing, mining, energy development, and recreation. These actions have the potential for ground disturbance, the removal or damage of cultural resources, access restrictions for Tribal uses, access leading to illegal collection and vandalism, and the potential for increasing erosion. Archaeological resources have been directly affected by such actions through the modification, displacement, and loss of archaeological materials, and thus the loss of valuable information regarding site function, dates of use, subsistence, and past environments.

Impacts on setting have occurred on some historic properties where setting is an integral component of integrity and NRHP significance. Impacts on the setting of Tribal resources have occurred from past or ongoing actions where setting is important to Tribal religious or cultural uses. Impacts on historic properties from past actions are more likely to have occurred prior to the implementation of NHPA Section 106 or where resources were not identified during inventories due to sampling strategies, dense vegetation, or other factors. Some impacts could still occur for specific archaeological resources that are not considered significant under NRHP criteria, are not identified during inventories, or for activities that are not subject to Section 106 review.

Wildfire has disturbed or caused the loss of cultural resources, primarily through direct destruction or modification of artifacts, structures, and other non-portable features and Tribal resource gathering areas. Wildfire has also exposed large areas where vegetation has burned, increasing the potential for illegal collecting of artifacts. Fire suppression often involves ground disturbance prior to the opportunity to identify and avoid significant resources and may result in damaging or destroying features and altering the spatial relationships of artifacts and features on archaeological sites. Air drops of fire retardant can cause damage to rock features due to rapid cooling of heated rock surfaces. The availability of certain Tribal plant resources and their habitats have been affected by human intervention in the natural role of wildfire, both pre- and post-contact. Past fire suppression policies allowed fuel loads to build up and altered the pre-contact fire regime.

Over time, impacts on cultural resources from natural processes, such as wildfire, erosion, drought effects, and weathering, will continue to affect the integrity of cultural resources. Such processes will continue to a greater or lesser extent regardless of the BLM's management strategies, although fuel breaks and enhanced rangeland restoration efforts may limit their effects. These processes represent a cumulative loss of the information and cultural values associated with these locations within the project area.

All the action alternatives propose restoration projects with the intent of restoring desired vegetation, creating a mosaic of vegetation communities, reducing continuous fuel loading, and lengthening fire return intervals. Implementing treatments across the project area could indirectly reduce the potential for cumulative impacts on cultural and Tribal resources. Fuels reduction would result in a decrease in the potential for cultural resource damage from fire, fire suppression, and erosion; however, fuels reduction may result in the loss of some pinyon nut resources valued by Tribes. The objective of pinyon-juniper treatments is to restore desirable understory vegetation by reducing competition from encroaching pinyon-juniper trees and also to reduce fuels. Restoration, however, would likely enhance the long-term availability of native plant resources for Tribal uses while avoiding ground-disturbing effects and other impacts on identified significant impacts during treatments.

The BLM's concurrent and reasonably foreseeable PEIS for Fuels Breaks in the Great Basin would also cumulatively protect cultural resources from wildfire. The system of fuel breaks would improve the BLM's opportunities to respond to wildfires throughout the project area and would thus cumulatively protect cultural resources across the landscape from wildfire and suppression activities. Potential cumulative effects could result from the treatment methods, the large scale of proposed treatment acres, and the increased potential for encountering unknown or unrecorded resources. The BLM would minimize such impacts by relying on project design features (Design Features 23-28), measures identified during the Section 106 consultation process, consultation with Tribes, and consideration of Tribal interests that would be implemented under all Fuel Breaks action alternatives. Design features would limit effects on cultural resources. Although there could be some localized effects on individual resources due to the proposed projects, the BLM does not expect that there would be a significant regional impact on cultural or scientific values under any of the alternatives in combination with other past, present, and reasonably foreseeable actions.

Alternative B would allow a wider range of treatment tools for new restoration projects. There would be fewer restrictions on vegetation types treated, and potential treatment areas would be expanded. The potential for encountering and potentially disturbing cultural and Tribal resources would be increased over Alternatives A, C, and D; thus, the potential for cumulative impacts from ground disturbance and pinyon removal could increase. Over the long term, however, Alternative B would restore desired vegetation, including plants that may be Tribal resources; remove available fuels; change fuel continuity; and lengthen fire return intervals, which would indirectly reduce the potential for cumulative impacts on cultural and resources.

Alternative C, which would limit fuels treatment and restoration methods and some treatable locations, would have less potential than Alternatives A and B to contribute to cumulative impacts on cultural resources due to ground disturbance and pinyon removal from treatments. In the long term, achieving treatment objectives would likely take longer because the BLM could not use the full suite of treatment and revegetation options. These limits could constrain the potential for reducing indirect impacts on cultural resources from wildfires and wildfire suppression and restoring desired vegetation.

Alternative D would allow the full range of treatment tools for new restoration projects. There would be fewer restrictions on vegetation types treated; however, potential treatment areas would be focused on priority emphasis areas. There would be far fewer potential treatment acres identified overall and specifically in the pinyon-juniper areas. The potential for contributing to cumulative effects from encountering and potentially disturbing cultural and Tribal resources from treatments would be less than under Alternatives B and C, but greater than under Alternative A. However, compared with the other action alternatives, Alternative D's focused approach with limited acres may be less effective in restoring desired vegetation, including plants that may be Tribal resources; removing available fuels; changing fuel continuity; and lengthening fire return intervals. Compared with the other action alternatives, Alternative D would be less effective in reducing the potential for adverse cumulative impacts on cultural resources from wildfire and wildfire suppression.

4.9 Paleontological Resources

4.9.1 Assumptions

- The probability of finding paleontological resources can be broadly predicted from the characteristics of geologic units exposed at or near the surface.
- This analysis provides a broad overview of estimated potential effects, based on available information. Existing information provides some insight into the potential for paleontological resources in the project area. However, data on the overall project area are incomplete and additional paleontological inventories may be necessary in areas where resources are likely in order to identify areas for avoidance or mitigation during local project implementation.
- The potential for impacts on both surface and subsurface paleontological resources, if would be proportional to the extent and depth of disturbance associated with the treatment type used, the resource type, and local geologic or soil conditions.
- In general, fossil localities that may be affected by shallow disturbance associated with treatments may be few. Fossil localities often do not support dense vegetation, which would limit treatment effects.
- Restoration projects may increase activity and provide easier access to paleontological resources, potentially leading to new discoveries or leading to unauthorized collection.

4.9.2 Nature and Type of Effects

Effects from Fuels Reduction and Rangeland Restoration Projects

Restoration projects have the potential to affect the physical integrity of surface and near surface fossil resources, and vegetation removal can temporarily increase erosional effects, and lead to greater exposure and visibility of fossils until vegetation is reestablished. Ground disturbing projects would be evaluated at the field office level to determine whether known significant fossil localities are mapped in the area, as well as whether further inventory is needed based on criteria set forth in Instruction Memorandum (IM) 2016-124 using the Potential Fossil Yield Classification (PFYC) mapping, if available, or geologic characteristics and previous study data, if not significant fossil resources. Project activities at potentially significant paleontological localities (those with important scientific, educational, or public interest values) would be coordinated with the regional BLM paleontologist to determine mitigation or monitoring needs according to applicable policies including BLM Manual 8270: *Paleontological Resource Management* and BLM Handbook 8270-1: If paleontological resources are encountered during project implementation, all ground-disturbing activity near the find would cease until the resource is evaluated by an appropriate BLM resource specialist (Design Feature 24).

Effects from Manual Treatments

Manual techniques are associated with very limited potential for impacts on fossil localities due to limited ground disturbance and the greater potential for identifying undiscovered resources as the work progresses versus mechanical means where operators are not in close visual contact with potential finds.

Effects from Mechanical Treatments

Depending on the specific tools and types of equipment used to remove plants, mechanical techniques can cause surface and near-surface disturbance that can directly damage and alter the spatial integrity and condition of any fossils that may be present. If surface fossils are present, treatments requiring heavy ground disturbance (disking, bulldozers, chains, trenchers, and plowing) would have greater potential for effects.

Effects from Prescribed Fire Treatments

Surface fossils may be damaged or destroyed by fire use. Potential impacts include spalling, fracturing, and heat alteration of fossils. Prescribed fire could increase exposure of fossil resources, potentially leading to erosion or unauthorized collection in the short term. The risk from fire is often limited by sparse vegetation in the vicinity of fossil localities.

Effects from Chemical Treatments

The use of chemical treatments may leave residues on fossils; however, chemical use may be preferred to mechanical and manual techniques. This is because the use of chemicals would avoid ground disturbance impacts.

Effects from Targeted Grazing Treatments

There would be some potential for surface and near-surface disturbance through trampling associated with targeted grazing treatments; however, this disturbance is not anticipated to be at a depth or intensity to cause significant impacts on paleontological resources.

4.9.3 Effects from Alternative A

Under Alternative A, there would be no programmatic analysis for restoration projects; actions for reducing the risk of impacts on paleontological resources would continue on a case-by-case basis. The potential for impacts from implementing restoration projects and the methods used under this alternative would be similar to those described for *Nature and Type of Effects*; however, they would not occur on a programmatic basis. The need for a paleontological inventory would continue to be determined using PFYC, if available, or geologic characteristics and previous study data, if not. However, without programmatic authorization of restoration projects and, in turn, improved region-wide ecosystem structure and function, the potential for reducing the impacts and risks from wildfires and wildfire suppression on paleontological resources would continue under current conditions.

4.9.4 Effects from Alternative B

Under Alternative B, treatment methods would have some limited potential for surface and near-surface disturbance on paleontological resources, if present, as described in *Nature and Type of Effects*. The full range of treatment tools could be used depending on vegetation state and desired conditions. The availability of tools and acreage that could be treated under Alternative B would result in improved ecosystem structure and function and, in turn, alter the behavior of wildfire on the landscape. Overall, this would reduce the risk from wildfires and wildfire suppression on paleontological resources over the long term. The expanded treatment methods and acreages would allow for greater flexibility in effectively locating and implementing treatments and thus greater chances of improving ecosystem structure and function across the project area.

4.9.5 Effects from Alternative C

As described in *Nature and Type of Effects*, manual and mechanical treatment methods have some limited potential for surface and near-surface disturbance on paleontological resources, if present. Limiting the types of treatments and the treatment acreage and excluding mechanical treatment of sagebrush would reduce the risk of new ground-disturbing impacts on paleontological resources. Limitations on treatments, however, may reduce the beneficial effects of improved ecosystem structure and function. Improved ecosystem structure and function would lengthen the wildfire return interval and reduce the length of the fire season. The potential for less frequent wildfire and improved ecosystem structure would reduce the risk on paleontological resources from wildfires (from spalling, fracturing, and heat alteration) and from fire suppression.

4.9.6 Effects from Alternative D

Alternative D would target previously defined priority emphasis areas for conservation and restoration for restoration projects. Alternative D would provide flexibility in allowing the full range of appropriate treatments the may improve ecosystem structure and function in the priority areas. There would be fewer restrictions on vegetation types treated, however, but far fewer potential treatment acres identified overall. The potential for impacts would be the same as identified in *Nature and Type of Effects,* but far fewer acres would be proposed for treatment. Lengthening the wildfire return interval and increasing restoration may be associated with an overall reduction in impacts on paleontological resources from wildfires and wildfire suppression over the long term, while avoiding significant fossil localities.

4.9.7 Cumulative Effects

Past and present cumulative actions in **Table 4-1** that involve ground disturbance may have affected paleontological resources, if present, through direct damage from construction, excavation, collection, and natural processes. These actions are fire suppression, fuel break construction, vegetation management, roads and utility ROWs, livestock grazing, mining, energy development, and recreational collecting. Natural processes, such as wildfires, erosion, and weathering, would also continue regardless of BLM-implemented treatments.

The potential for impacts from reasonably foreseeable future actions would be similar to the past and present actions' potential. Actions involving construction and excavation, as well as natural processes, would increase the potential for disturbing the ground and consequently increasing the potential to damage, destroy, remove, expose, or bury paleontological resources throughout the cumulative effects analysis area. All the action alternatives would propose restoration projects with the intent of restoring desired vegetation, removing available fuels, changing fuel continuity, and lengthening fire return intervals. The addition of large-scale treatments would be associated with surface and near-surface disturbance in the project area, which may damage paleontological resources, if they are present but not identified for avoidance during treatment. Potential cumulative effects could result from the treatment methods, the large scale of proposed treatment acres, and the increased potential for encountering unknown or unrecorded resources. The BLM would minimize such impacts by relying on project design features and field office project review of the potential for disturbance of paleontological resources per BLM policies and in coordination with the BLM regional paleontologist.

Implementing treatments across the project area could also indirectly reduce the potential for cumulative impacts from fire and fire suppression on paleontological resources. Treatments would alter the vegetation communities, improve ecosystem structure and function, change the movement and behavior of wildfire across the landscape, and reduce the need for creation of fire lines created during wildfire suppression activities that could damage known or unknown resources. These results would aid in the return of historical wildfire patterns, reducing the frequency and the spread of fire; they may reduce the long-term potential for fossils to be lost during wildfires and wildfire suppression.

The BLM's concurrent and reasonably foreseeable PEIS for Fuels Breaks in the Great Basin proposes actions that would also cumulatively reduce the potential for impacts on paleontological resources from wildfire. The system of fuel breaks would improve the BLM's opportunities to respond to wildfires throughout the project area and would thus cumulatively protect paleontological resources across the landscape from wildfire and suppression activities. Potential cumulative effects could result from the treatment methods, the large scale of proposed treatment acres, and the increased potential for encountering unknown or unrecorded resources.

BLM-authorized present and reasonably foreseeable actions would be subject to site-specific project and compliance review. Treatments would occur at the local level; inventories would focus on more likely locations for encountering paleontological resources, so some resources could be missed.

BLM resource management plan allocations and other federal, state, or local requirements, planning, protection, or process requirements also reduce the potential for impacts on paleontological resources. Although there could be some localized effects on individual resources due to the proposed projects, the BLM does not expect that there will be a significant regional impact on scientific values under any of the alternatives, in combination with other past, present, and reasonably foreseeable actions.

Alternative B would allow a wider range of treatment tools for new restoration projects. There would be fewer restrictions on vegetation types treated, and potential treatment areas would be expanded. The potential for encountering and potentially disturbing paleontological resources would be increased over Alternatives A, C, and D; thus, the potential for cumulative impacts would increase. Over the long term, however, Alternative B would restore desired vegetation, remove available fuels, change fuel continuity, and lengthen fire return intervals, which would indirectly reduce the potential for cumulative impacts on paleontological resources from wildfire and wildfire suppression.

Alternative C, which would limit treatment methods, would have less potential than Alternatives A and B to contribute to cumulative impacts from treatments. In the long term, achieving treatment objectives would likely take longer and the potential for reducing indirect impacts from wildfires and wildfire suppression may be limited. This is because the full suite of treatment and revegetation options could not be used.

Alternative D would allow the full range of treatment tools for creating new restoration projects and fewer restrictions on vegetation types treated. Treatment areas would be focused on priority emphasis areas; thus, far fewer potential treatment acres are anticipated. The potential for contributing to cumulative impacts and encountering and potentially disturbing paleontological resources would be less than Alternatives B and C, but greater than Alternative A. However, Alternative D's focused approach with limited acres may be less effective in restoring desired vegetation, removing available fuels, changing fuel continuity, and lengthening fire return intervals than the other action alternatives. Compared with the other action alternatives, Alternative D would be less effective in reducing the potential for adverse cumulative impacts on paleontological resources from wildfire and wildfire suppression.

Overall, when combined with past, present, and reasonably foreseeable actions, none of the actions would be likely to limit the overall ability of significant paleontological resources to answer important scientific questions within the project area.

4.10 Recreation

4.10.1 Assumptions

- The BLM may temporarily limit recreation opportunities during treatments, which could range from hours to several growing seasons.
- Impacts from treatments on recreation experiences would be greater in areas of abundant recreation opportunities than in those with limited opportunities.

4.10.2 Nature and Type of Effects

Recreation setting, experiences, and opportunities may be directly affected in the short term from restoration projects by increased noise and exhaust smells from chainsaws, power tools, and heavy equipment, or by a reduction in visibility and air quality during prescribed fires. Further, restoration projects may require temporary restrictions on access to both developed and undeveloped recreation sites. This could result in localized and temporary displacement of recreation opportunities to other areas. Increased visitation to nearby sites could potentially decrease the quality of the recreation experience at these sites due to overcrowding. This displacement would last for the duration of fuels reduction or rangeland restoration treatments, which could extend more than one growing season. During seasons when recreation activity is generally high, such as summer or hunting season, some activities may be disproportionately affected by restoration projects when compared with those activities taking place during lower-activity seasons.

Increased human presence during restoration treatments may affect hunting opportunities over the short term. The removal of vegetation would cause both short- and long-term displacement of hunting opportunities by reducing or removing cover and forage for both big game and fur-bearing game species. Impacts would be concentrated within the treatment areas and would dissipate as distance from treatment area increases. In the long term, vegetation with higher resistance and resilience would contribute to improved overall habitat conditions in the project area, which would maintain and enhance hunting opportunities.

The removal, modification, or replacement of vegetation during restoration treatments could also modify the visual quality of the recreation setting over the short term. For instance, treatments may reduce visual quality for hiking, mountain biking, and OHV trails in the short term; however, restored rangeland is likely to improve visual quality in the long term.

Restoration projects under any of the action alternatives would contribute to the long-term resistance and resilience of vegetation across the landscape resulting in a reduction of fire's effects on recreation through fewer acres burned and a longer fire return interval. This would minimize effects on recreation from a modified recreation setting, closure of recreation sites during fire suppression activities, and lost opportunities for recreation in newly burned or currently burning areas.

4.10.3 Effects from Alternative A

Under Alternative A, there would be no programmatic analysis for fuels reduction and rangeland restoration projects. The BLM would continue to implement vegetation management throughout the project area on a site-specific basis, as discussed in **Table 4-1**. Large fuels reduction and rangeland restoration projects would still occur within the project area, and as a result would likely reduce the impact of wildfire on the quality of the recreation setting. However, all future vegetation management projects would not be part of a programmatic vegetation management program and would require additional NEPA analysis.

Wildfires with a shortened fire return interval are likely to continue in the project area. Wildfires and their suppression activities would have direct effects on the recreation setting and opportunities, primarily in the summer when the fire season is at its peak. More frequent fires may alter large swathes of the landscape by removing native vegetation and increasing the spread of invasive annual grass, which would alter the recreation setting. For instance, invasive annual grasses may cure and turn brown earlier in the season, which may contribute less to a positive recreation experience than live, green vegetation. Wildfires may also damage trails and recreation facilities and could result in temporary access restrictions of recreation sites when fires are nearby.

Smoke and dust from wildfires would decrease the quality of the recreation experience for visitors and could preclude certain activities. Dozer and hand lines created during fire suppression may become unofficial trails, which could increase the incidence of unauthorized OHV travel. These linear disturbances may degrade the recreation setting and detract from the recreation experience for some users; however, they would be identified for rehabilitation soon after creation, which could eliminate the potential for impacts. In the long term, there would be the potential for wildfires to displace visitors and directly and indirectly modify recreation settings and experiences, especially in areas dominated by invasive annual grass.

4.10.4 Effects from Alternative B

Impacts from Alternative B would be as described in *Nature and Type of Effects* and Alternative A. Compared with Alternative A, using the full suite of tools on a larger potential treatment area would temporarily displace recreationists, alter the recreation setting from vegetation removal, reduce visibility due to smoke from prescribed fire, degrade experiences from increased noise and exhaust smells from power tools and heavy equipment, and increase surface disturbance and displace visitors during mechanical treatments and targeted grazing.

Under this alternative, however, recreationists would be likely to benefit to a greater extent than under Alternative A through long-term improvements to the recreation setting. This is because a transition to a desired vegetation condition would result in few acres burned, and longer fire return intervals, that may increase the desirability of recreation sites.

Specific design features include the addition of signs during treatment activities to prohibit public access and to protect public health (Design Features 5 and 12, **Appendix D**). These design features would reduce the impacts on the recreation setting resulting from treatments under Alternative B. For instance, treatments would take place where there would be minimal disturbance to visual qualities, and treatments involving soil disturbance would incorporate invasive annual plant management to prevent their invasion after treatments.

Under Alternative B, the BLM would use certain treatments methods based on the existing vegetation state, as described in **Table 2-1**. Restricting treatment methods in specific vegetation states would limit the impacts on recreation settings and experiences in those areas.

4.10.5 Effects from Alternative C

Under Alternative C, impacts from the use of manual and mechanical methods would include temporary access restrictions during treatment intervals and temporary degradation of the recreation setting through increased human presence and treatment activity. Under Alternative C, the BLM would limit treatments based on the existing vegetation state, as described in **Table 2-2**. Restricting treatments in areas under specific vegetation states, such as Shrub with Depleted Understory, would limit the geographic impacts of treatments; thus, there would likely be no direct impact on recreation settings and experiences in those areas. In addition, design features incorporated under this alternative would include measures to prevent impacts on recreation settings and experiences.

4.10.6 Effects from Alternative D

Impacts on recreation under Alternative D would be similar to those described under Alternative B and those described in *Nature and Type of Effects*. Under Alternative D, the BLM would use a full suite of tools for restoration projects, and there would be limited constraints on the location of treatments in the project area. Treatments, however, would potentially take place only within FIAT planned treatment areas and are unlikely in Pinyon-Juniper Phase III, which would limit impacts when compared with Alternative B. Design features would be the same as described for Alternative B.

4.10.7 Cumulative Effects

Recreation experiences could be cumulatively affected by past, present, and reasonably foreseeable projects, plans, and actions, including fire and vegetation management, land use plans, resource management plans, and human and energy development. Wildfires are likely to persist, which may contribute to the conversion of woody vegetation to invasive annual grasses, reducing the quality of the recreation experience. The movement toward invasive annual grass communities would also lead to more frequent fires, which would displace visitors and modify the settings that contribute to positive recreation outcomes. Past, present, and reasonably foreseeable future actions, including past and ongoing treatments, have the potential to displace visitors, affect visitor experiences, and modify the recreation setting that contributes to positive recreation outcomes. In the long term, fire and vegetation management projects may help to protect the recreation setting and lead to a more desirable recreation experience.

In areas with past or ongoing mineral development, grazing, or ROW activity, visitors are already being displaced and other land uses are influencing the recreation setting. The magnitude of these impacts is intensifying with increasing visitation to the project area. Continued road and ROW construction and other infrastructure development may adversely affect recreation settings and experiences over the short term through temporary access restrictions and a reduction in recreation opportunities. Changes to land or resource management also may displace or alter the availability of recreation opportunities in the project area.

Proposed treatments under the action alternatives would further displace visitors and affect the setting in the short term; however, in the long term, the extent of displacement would return to baseline conditions as treatment areas are made available for use, while the quality of the setting would improve. The intensity of cumulative impacts from treatments would be the least where there are the fewest past, present, and reasonably foreseeable future actions, such as grazing, ROWs, and mineral development. In these areas, temporary closures from treatments would displace visitors from otherwise unobstructed opportunities and settings. In the long term, however, restoring the desired vegetation conditions and historical fire regimes to all areas through treatments would cumulatively improve the recreation setting and experiences. This is because visitor displacement and recreation setting modification in a given area from wildfires would occur less frequently, and the Perennial Grasses and Shrubs vegetation state would contribute to a more positive recreation setting and experience compared with vegetation states with invasive annual grass components.

Overall, Alternative C is likely to have the fewest long-term, beneficial impacts on the recreation settings and experiences. This is because it would provide the fewest opportunities to restore ecosystems in the project area, while Alternative B is likely to have the most long-term, beneficial impacts by providing the greatest opportunities through tools and areas available to improve recreation settings and experiences.

4.11 Lands with Wilderness Characteristics

4.11.1 Assumptions

- Under all action alternatives, restoration projects would only take place on lands with wilderness characteristics where the applicable resource management plan, as amended, emphasizes other multiple uses (with or without management restrictions) as a priority over protecting wilderness characteristics. Lands with wilderness characteristics identified in an adopted plan as being managed specifically for the protection of wilderness characteristics as a priority over other multiple uses would be excluded from treatments.

4.11.2 Nature and Type of Effects

Restoration projects may have short- and long-term impacts on wilderness characteristics in the project area. Activities with the potential to affect lands with wilderness characteristics are the increased presence of humans and vehicles, increased surface disturbance and soil compaction, noise and smells associated with power tools and heavy machinery, and temporary road restrictions. Impacts associated with these activities are a loss of naturalness through human alteration of the landscape, as well as the noises, smells, and visual disturbance brought about by reducing fuels. Noise related to the removal of vegetation may also affect solitude and primitive and unconfined recreation opportunities, though these impacts are likely to be short term, lasting only the duration of treatment activities. Short-term road restrictions near LWCs during treatments could affect access to lands with wilderness characteristics for recreation (see **Section 4.10**, Recreation). Naturalness of the landscape may be temporarily affected through vegetation removal; however, restoring rangeland vegetation would lead to a long-term enhancement of apparent naturalness to lands with wilderness characteristics.

Over the long term, by moving towards desired conditions through restoration projects, resistant and resilient vegetation would be less available to burn, thus reducing the need for fire suppression. This would decrease the frequency and longevity of impacts on lands with wilderness characteristics from fire suppression activities, such as the digging of fire lines or trammeling by fire crews.

4.11.3 Effects from Alternative A

Under Alternative A, restoration projects would need to undergo site-specific analysis and approval before implementation. Large restoration projects would still occur within the project area, thus protecting lands with wilderness characteristics; however, these projects would not be programmatic and would require additional NEPA analysis. The current trend of frequent wildfires in the project area would likely continue; however, there would be no immediate direct impacts on lands with wilderness characteristics, and they would remain at their current state.

More frequent and uncontrollable wildfires, however, may result in the loss of some supplemental values within the boundaries of the lands with wilderness characteristics, including altering or destroying scientific research areas or paleontological and historic resources. There would be no design features in place to protect such resources. Wildfires may also result in widespread ecosystem alterations, such as intensifying cheatgrass invasion, which could move the landscape away from a natural state. Additionally, dozer and hand lines may need to be created to control wildfires, which could lead to a loss of apparent naturalness and a loss of solitude, due to the presence of firefighting resources.

4.11.4 Effects from Alternative B

Impacts from actions under Alternative B would be as those described in *Nature and Type of Effects*. A full suite of treatment methods would be used under Alternative B, which could diminish apparent naturalness and opportunities for solitude and primitive and unconfined recreation in the project area. Manual methods of vegetation removal would be likely to have the least impact on lands with wilderness characteristics, though the use of chainsaws and brush saws would create sounds and smells that could reduce opportunities for solitude. Likewise, dozers, masticators, and mowers used for mechanical treatments would increase noise above ambient levels and could create exhaust smells. Use of heavy equipment would also compact soils and increase the overall surface disturbance in the treatment area. Large equipment would have to be transported to treatment sites, which would increase traffic and could result in temporary road restrictions. During treatments, road improvements and maintenance (within the current definition or designation) would likely be accompanied by short-term increases in noise and surface disturbance, which could negatively affect wilderness characteristics. The use of prescribed fire would have short-term and localized reductions in air quality and visibility, which would affect the apparent naturalness of lands.

Design features (**Appendix D**) built into the action alternatives would help to mitigate some impacts of treatments on lands with wilderness characteristics. The BLM would temporarily prohibit entry to areas during chemical treatments, prescribed burns, and targeted grazing and would use signs to prevent impacts on human health and safety. Additionally, design features would be in place to prevent soil disturbance and the spread of invasive annual plants by using pre- and post-work evaluations and monitoring, as described in **Section 4.2,** Vegetation. Over the long term, treatments under Alternative B would be likely to lead to the greatest improvements in apparent naturalness of lands with wilderness characteristics.

4.11.5 Effects from Alternative C

Treatments under Alternative C would be limited to manual and mechanical methods; impacts would be as described in *Nature and Type of Effects*. Impacts, however, would be diminished under this alternative. This is due to the restricted treatment methods and limitations on vegetation states in which they could take place. Lands with wilderness characteristics would be affected through temporary access restrictions of treatment areas during implementation, as well as increased noise and exhaust smells. These impacts would be short term, lasting for the duration of treatments.

When compared with Alternative A, actions under Alternative C could lead to improved apparent naturalness of lands with wilderness characteristics and would reduce the impacts of the presence of firefighting resources over the long term. Design features incorporated under this alternative would limit impacts on lands with wilderness characteristics through preservation of scenic values, minimization of new surface disturbance, and revegetation.

4.11.6 Effects from Alternative D

Impacts from a full suite of treatment methods on lands with wilderness characteristics under Alternative D would be similar to those described for Alternative B and *Nature and Type of Effects*. Impacts, however, are likely to be reduced under Alternative D. This is because the BLM would limit treatments to FIAT planned treatment areas and treatments in Phase III Pinyon-Juniper vegetation states would be unlikely; thus, there would likely be no direct impact on wilderness characteristics in those areas. Design features and associated impacts would be the same as described for Alternative B.

4.11.7 Cumulative Effects

Lands with wilderness characteristics could be cumulatively affected by past, present, and reasonably foreseeable projects, plans, and actions, including management direction in land use plans and resource management plans, fire and vegetation management projects, human and energy development, and construction of roads and ROWs. There may be positive and negative impacts from road construction and improvements, as higher-quality roads may increase access but detract from solitude; opportunities for solitude would likely remain near their current levels and would not be diminished over the long term. Further, development of ROWs and other infrastructure may have negative impacts similar to those from road development.

Without additional management direction for new fuels reduction or rangeland restoration projects, current wildfire trends are likely to persist. More frequent and severe wildfires may contribute to the impacts from past, present, and reasonably foreseeable actions by increasing the loss of apparent naturalness via ecosystem alterations and the loss of opportunities for solitude through increased human and vehicle presence during wildfire suppression activities. Proposed activities under Alternative B would combine with past, present, and reasonably foreseeable future actions to increase the effectiveness of fuels reduction and rangeland restoration projects to the greatest extent over the long term; however, a full suite of treatment methods would be used under this alternative. This would increase the cumulative, short-term adverse impacts on apparent naturalness and solitude from vegetation treatments and human presence on lands with wilderness characteristics while the treatments occur.

In areas with past or ongoing land use activities, such as mineral development, grazing, or ROWs, apparent naturalness is already being affected. Proposed treatments under the action alternatives would further affect apparent naturalness in the short term; however, in the long term, treatments would incrementally improve apparent naturalness. The intensity of cumulative impacts from treatments would be the least where there are the fewest past, present, and reasonably foreseeable future actions, such as grazing, ROWs, and mineral development. In these areas, treatments would have a more noticeable effect on naturalness. In the long term, however, restoring desired vegetation condition and historical fire regimes to all areas through treatments would reduce the amount of acres burned that affect apparent naturalness.

Activities under Alternative C would combine with past, present, and reasonably foreseeable future actions to increase the effectiveness of treatments to a greater extent than under Alternative A, but to a lesser extent than under Alternatives B and D. Actions under Alternative C would lead to a short-term, cumulative reduction in opportunities for solitude from noise and human presence associated with treatments. Over the long term, actions under Alternative C, even when combined with other vegetation management projects, may not provide adequate opportunities to improve current conditions, leading to increased potential for impacts on lands with wilderness characteristics.

Effects from past, present, and reasonably foreseeable future actions on lands with wilderness characteristics under Alternative D would be similar to those described under Alternative B. However, proposed activities under Alternative D, combined with past, present, and foreseeable future actions, would have a decreased effectiveness when compared with Alternative B due to constraints on treatment locations.

4.12 SOCIAL AND ECONOMIC IMPACTS

Social and economic impacts are summarized below. Current conditions affecting the social and economic conditions in the six-state project area are provided in **Section 3.11** and the Socioeconomic Baseline Report (BLM 2018).

4.12.1 Nature and Type of Effects

Treatments could result in direct impacts on costs of treatment and BLM budgets. The level of impacts would vary, based on the type, number, and location of treatments and total acres treated. Project-specific estimates for treatment costs are not available. **Table 4-8**, below, summarizes general ranges of per-acre treatment cost, based previous BLM costs.

Restoration projects may result in short-term job opportunities, labor income, and value added to the regional economy. Impacts are likely to be site specific and limited and would result in minimal contributions to the overall regional economy. Economic contributions would be determined at the site-specific implementation level.

Table 4-8
Estimated Cost of Treatments in Sagebrush Habitat (2017 dollars)

Method	Cost per Acre
Prescribed burn (aerial)	$15,000/day
Prescribed burn (hand ignition)	$40
Administrative costs (e.g., inventories and monitoring)	$10-50+
Mechanical treatment	$40-300
Chemical treatment	$35-200+
Seed type	$75-250
Conifer removal	$50-500

Sources: BLM 2019b

Proposed restoration projects could move vegetation toward higher resistance resilience and historical fire regimes. This could indirectly lengthen fire return intervals and alter wildfire seasonality, as discussed in **Section 4.3**, Fire and Fuels. As discussed in the Socioeconomic Baseline Report (BLM 2018), wildland fire results in direct and indirect spending. Should a large wildfire occur, economic repercussions could include short-term increases in economic contributions during and directly following the fire. Local communities and businesses may benefit from fire suppression spending during this time, and local labor markets may be positively supported by suppression activities; however, capturing this spending by local contractors and vendors is variable and often depends on the fire location and competition with nationwide vendors.

In the long term, in the event of wildfire, a decrease may be seen in other local economic sectors based on changes to the local environment and community. A Rollins 2008 study found that overall county employment and wages increase during wildfires, but natural resource and hospitality sectors of employment faced long-term decreases in employment and wages following large wildfires (Moseley

2010). This may also include greater economic instability and may amplify seasonal variations in employment in areas that depend highly on these economic sectors.

As discussed in the Socioeconomic Baseline Report (BLM 2018), vegetation treatments can result in reduced fire suppression costs. Rollins and Kobayashi (2010) examined wildfire suppression costs in sagebrush communities in the Great Basin that were avoided through fuels reduction treatments. They estimated that fuels reduction treatments that focused on invasive annual grass reduction resulted in a cost savings of up to $69 dollars per acre over the next 200 years when the cost of treatment is taken into account. Savings, however, were found to vary based on the baseline vegetation type and condition and costs of treatment. The highest savings in suppression costs in this study were expected in closed canopy pinyon-juniper areas with cheatgrass, because these areas currently have the highest suppression costs (Rollins and Kobayashi 2010).

In addition, actions that result in longer fire return intervals and reduction in fire season length may result in decreased costs for suppression and risks to firefighters. As discussed in the Socioeconomic Baseline Report, altering wildfire seasonality is one factor affecting total budget for fire suppression activities, and the increase in budget over the past decade. In terms of fire return intervals, a habitat-restoration project that could reduce rangeland fires to a recurrence frequency of once every 60 to 110 years rather than once every 3 to 5 years was estimated to result in a savings of in excess of $180,000,000 or more (BLM 2014).

Proposed treatment and restoration activities that result in a long-term improvement in an ecosystem's ability to recover after disturbance may also reduce fire-related costs. This is because direct rehabilitation costs may represent as much as 45 percent of total fire costs (Western Forestry Leadership Coalition 2010).

Proposed treatments could temporarily displace some current land uses with economic and social importance for communities. Should restrictions occur on other resources, this could affect the public's ability to access these resources and uses, as well as the jobs, income, and public lands receipts associated with them. The level of impacts on economic contributions would depend on an alternative source for the specific resource or resource use in the area. Should alternative sources be available, economic output would not be affected. Direct impacts from proposed management activities are likely to be site specific and limited and, therefore, are likely to have minimal impacts on regional economic contributions.

Under all alternatives, no changes to grazing permits would occur as a result of decisions associated with this analysis, but temporary restrictions may be in place to facilitate treatment or restoration. Restrictions could affect ranch operations, and the level of impacts would depend on the degree that the proposed management would exclude livestock during authorized seasons of use and the level to which individual operators are specifically affected; this would be determined at the site-specific stage. Design features for targeted grazing (**Appendix D**, Design Features 15-18) could reduce the potential for impacts on permitted grazing operations. Targeted grazing treatments represent short-term, localized opportunities for increased economic contributions and employment in the agricultural sector.

Likewise, temporary displacement of recreation activities could occur. These temporary restrictions could displace recreationists from preferred recreation sites or change the recreation experience at these sites. This could affect both quality of life associated with recreation and economic contributions from this sector, should regional use and spending be affected (see also **Section 4.10**, Recreation).

There could be site-specific, long-term impacts on the type or availability of woodland products due to changes in vegetation (see **Section 4.2**, Vegetation). This could affect receipts from this land use. The intensity of impacts would be affected by the acres treated and the existing vegetation types and condition in treated areas. Woodland product receipts in sagebrush habitat are likely associated with pinyon-juniper vegetation states, producing such materials as fuelwood, posts, poles, and other wood products, primarily for individual use or local sale. Removing pinyon-juniper vegetation by manual or mechanical treatment could reduce the vegetation available for this use. Changes to receipts would most likely occur when woody vegetation is converted to Perennial Grasses and Forbs and Perennial Grasses, Forbs, and Shrubs vegetation states. Phase I Pinyon-Juniper vegetation states are likely to represent only small contributions to woodland products because of the small size and low density of the trees; therefore, vegetation changes to this area may have limited impacts. In the long term, management that decreases the potential for high-severity fires would limit the loss of woodland products from wildfire and would support continued contributions from public lands in the project area.

Proposed treatment activities of all types could affect ecosystem services on BLM-administered lands. In the short term, treatment could affect the visual setting and associated cultural ecosystem service contributions. Measures that limit actions in riparian, conservation, and special designation areas would minimize impacts.

In the long term, management that decreases the potential for high-severity fires would limit impacts and support continued contribution of ecosystem services from public lands in the project area. Should a fire occur, wildfire smoke would result in short-term impacts on air quality, with impacts on public and environmental health and, later, reduced water quality from sediment and ash runoff.

Burned areas, once used for recreation or valued for their scenic beauty, could take lifetimes to fully recover, affecting local residents' quality of life and sense of place. Visitors' preference for moderately burned areas can return in the initial years after a fire. Severely burned landscapes can take much longer to return to desirable recreation conditions, which would affect recreation demand and ecosystem services (Bawa 2017).

4.12.2 Effects from Alternative A

Under Alternative A, restoration projects will need to undergo site-specific analysis and approval before implementation. No direct impacts would occur on the BLM's costs, economic contributions, or other land uses as a result of the proposed activities; instead, restoration projects would continue on a site-specific basis only. The absence of a programmatic EIS for fuels reduction and rangeland restoration projects would result in continued departure from historical fire regimes; however, improvement in conditions may occur at a local level as a result of site-specific projects completed independent of the PEIS. As a result, fires may continue to occur at more frequent intervals, and will continue to burn large areas. Should a wildfire occur, there could be impacts on local economies and community setting, as described in *Nature and Type of Effects*.

4.12.3 Effects from Alternative B

Allowing for a full suite of vegetation management tools under Alternative B (see **Table 2-1**) would increase the costs of treatment for the BLM and the potential for direct economic contributions from treatment, as described in *Nature and Type of Effects*. Management actions under Alternative B would increase plant community diversity, conserve current plant community structure, restore herbaceous understory, and restore heterogeneity along high-value connectivity corridors.

This alternative would result in the greatest flexibility for management, which would support the maximum potential for moving vegetation towards more historical conditions, reducing available fuels, lengthen the fire return interval and fewer acres burned. As a result, the long-term potential to decrease fire suppression costs and the social and economic impacts from wildfire would be greatest under this alternative, as discussed in *Nature and Type of Effects*; however, as described in *Nature and Type of Effects*, there would be a potential for impacts on other land and resource uses, and economic and social contributions from these uses, in the potential treatment area (see **Section 2.4.2** and **Map 2**). Design features (**Appendix D**) applied under Alternative B would reduce impacts on other resources.

Treatments would more effectively improve ecosystem structure and function when compared with Alternative A. This would reduce acres burned and alter fire movement, which would reduce economic instability and preserve nonmarket values. Indirect impacts on ecosystem services would include preserving air and water quality, visual setting, and other components affecting recreation use and enjoyment.

4.12.4 Effects from Alternative C

Alternative C would implement only manual and mechanical methods to meet fuels reduction and rangeland restoration goals. This would result in site-specific costs for treatment for the BLM and a low level of direct economic contributions from treatment, as discussed in *Nature and Type of Effects*. Treatment costs would be elevated over Alternative A.

Compared with Alternative A, restoration projects under Alternative C could help to move vegetation towards more historical conditions, reduce available fuels, lengthen fire return intervals and reduce acres burned (see **Section 4.3**, Fire and Fuels). As a result, the impacts on social conditions, economic contributions, and ecosystem services from wildfire, as discussed in *Nature and Type of Effects*, would be reduced; however, limiting treatment tools under Alternative C could reduce the effectiveness of treatment. Potential impacts on other land and resource uses, and economic and social contributions from these uses, could occur in the potential treatment area (see **Section 2.4.3** and **Map 3**), as described in *Nature and Type of Effects*.

4.12.5 Effects from Alternative D

Impacts under Alternative D would be similar to those under Alternative B; however, Alternative D limits treatment to the 5.6 million acre potential treatment area that corresponds with the FIAT planned treatment areas (see **Section 2.4.4** and **Map 4**). Management of pinyon-juniper would be focused on Phase I and Phase II Pinyon-Juniper areas, which would reduce the potential for impacts on fuel wood and wood products. Potential impacts on other land and resources uses, and social contributions from these uses, would be similar to those under Alternative B.

4.12.6 Cumulative Effects

The cumulative effects analysis area for socioeconomic impacts is the six-state project area. This is because social and economic impacts extend beyond public land boundaries to surrounding communities. The time frame for the cumulative effects analysis is the life span of this PEIS, because fuels reduction and rangeland restoration projects would occur intermittently over this period.

As summarized in **Table 4-1**, past, present, and reasonably foreseeable future actions that could cumulatively affect social and economic cumulative impacts are historic fire suppression, ongoing and future fuel break projects, vegetation treatments, human developments, roads and ROWs, and the spread of invasive annual grass. Effects from these human actions and natural processes are briefly discussed below.

As discussed in the affected environment, historical and ongoing fire suppression have affected vegetation conditions and altered fire regimes and affected the costs of fire suppression activities and post-recovery efforts, as well as the social costs for communities when fire occurs. Ongoing fuel break projects may result in site-specific reductions in fire size and increase the ability to effectively suppress fires, reducing the associated costs. Vegetation treatments would continue to improve vegetation cover and structure, which in turn influence fire return intervals and acres burned and associated costs in locations where treatments have occurred. Impacts on social and economic conditions would vary on a site-specific basis depending on the size of the project, treatment methods, and the type of targeted vegetation; they could include short-term, site-specific limits on access for other resource uses. Resource management/land use planning could also contribute to a cumulative reduction in fire risks and costs by providing a framework for vegetation objectives; however, impacts would vary based on site-specific plan direction.

Human developments, such as construction projects and development of roads and ROWs in the project area, have and would continue to result in increased development and associated infrastructure. This would increase values at risk requiring protection should a fire occur, therefore increasing fire suppression costs. In addition, ignition of fuels on or adjacent to roadways represents a source of fire starts; therefore, proposed development of roads and ROWs would increase the potential for human-caused fire.

In the long term, continued ecological trends could perpetuate or increase shortening of fire return intervals, maintain or increase the potential for increases in acres burned and continue to influence the pattern of fire and associated risks and costs in the project area. Should a wildfire occur, there could be impacts on local economies and community settings related to immediate suppression efforts and, later, the costs of lost infrastructure and postfire reconstruction. This could contribute to local decreases in economic contributions, a loss of economic stability for affected communities, and a loss of nonmarket values.

As discussed under direct and indirect impacts, a full suite of vegetation management tools under Alternative B would result in short-term, site-specific costs for treatment for the BLM and a low level of direct economic contributions with minimal cumulative contributions to the local economy. Under Alternative B, there would also be more potential for impacts on other land and resource uses, and the economic and social contributions from these uses, as compared with Alternative A. For example, loss of recreation opportunities would be greater due to the increased potential to affect large acreages simultaneously. Flexibility in treatment location may also allow for treatments in areas likely to maximize impacts on lengthening the fire return interval and decreasing acres burned in the project area. This would reduce the economic and social impacts from wildfire, including suppression and reconstruction costs. In addition, reduced fire risks would result in less economic instability, while preserving nonmarket values compared with Alternative A.

Restrictions on treatments would limit the direct impacts on other resources from treatments and the associated economic and social contributions from these resources. Under Alternative C, allowing only manual and mechanical treatments would limit the impacts at the landscape levels compared with other action alternatives. The impacts on vegetation changes under Alternative C would be more limited than those described under Alternative B, due to restrictions on some treatment.

Impacts under Alternative D would be similar to those under Alternative B. The potential to contribute to a cumulative lengthening of fire return intervals, fewer acres burned, and reduce fire-related costs would be slightly decreased due to reduced flexibility in the location of treatments.

4.13 Environmental Justice

Based on the CEQ guidelines as discussed in **Section 3.11**, Social and Economic Conditions, populations have been identified within the project area for further environmental justice consideration at the county level. Counties identified as low-income or minority populations, or both, include 10 counties in Idaho, 27 counties in California, 1 county in Nevada, 1 county in Utah, and 5 counties in Washington (see also BLM 2018).

Site-specific projects would require further assessment of potential environmental justice impacts. This is because the locations of future site-specific fuels treatment projects remain unknown; thus, it is difficult to ascertain how such projects may affect populations identified for further environmental justice consideration.

4.13.1 Nature and Type of Effects

Changes in the level of access to resources and resource uses could limit traditional, subsistence, cultural, or economic use, thereby affecting the social and economic well-being of environmental justice populations. The types of short-term impacts that could occur from the management actions are as follows:

- Direct tree removal through proposed vegetation management actions or indirect loss of vegetation as a result of wildfire can reduce the amount of potential fuelwood for individuals who heat their home by firewood, which may play a more important role in low-income communities. Vegetation impacts are discussed in **Section 4.2**, Vegetation.
- Subsistence hunters may be affected by impacts on wildlife or habitat. For direct, indirect, and cumulative impacts on wildlife, please refer to **Section 4.7**, Wildlife.
- Tribal communities who use vegetation for cultural practices could be affected, as discussed in **Section 4.8**, Cultural and Tribal Resources.
- Treatments could affect the social and economic well-being of all populations, including environmental justice populations, as discussed in **Section 4.12**, Social and Economic Impacts. Restoration projects are designed to move vegetation toward historical conditions and lengthen fire return intervals. In the absence of treatments, the vegetation would remain departed from historical conditions; a more frequent fire interval would persist, with the potential for increase in acres burned. Some potential impacts include destruction of public and private property, and changes to the community social structure.
- Restoration projects could affect the public health of local populations, including environmental justice populations, as discussed in **Section 4.12**, Social and Economic Impacts and **Section 4.4**, Air Quality.

The level of impacts on minority, low-income, and Tribal populations and whether minority populations are particularly vulnerable to these impacts or are more likely to be exposed to such impacts also depend on the specific location of proposed actions in relation to identified populations. Site-specific locations, timing, and details of treatment methodology will not be identified in this programmatic document. Impacts are likely to be limited and site specific in nature; however, site-specific impacts would need to be analyzed to determine the potential for disproportionate adverse impacts on specific low-income, minority, or Tribal populations before site-specific implementation.

4.13.2 Effects from Alternative A

Under Alternative A, vegetation restoration projects completed independent of this PEIS would need to undergo site-specific analysis and approval before implementation. Vegetation management actions would continue to be employed throughout the project area on a site-specific basis as discussed in **Chapter 3** and in **Table 4-1**. Ecosystem trends and processes would continue the current trends. While local changes may occur due to site-specific treatments, the absence of a programmatic EIS for fuels reduction and rangeland restoration could result in continued departure from historical fire regimes for the overall planning area. Should a wildfire occur, adverse impacts would be present for all populations, including environmental justice communities.

4.13.3 Effects from Alternative B

Alternative B allows for the use of the full suite of management tools with the fewest constraints on treatments. Consequently, it contains the highest potential for short-term, direct impacts from management actions on adjacent communities, including low-income, minority, and tribal populations, from restoration projects.

Under Alternative B, the BLM would allow for all types of tools available to reduce fuels and restore vegetative desired conditions. Allowing mechanical treatments in sagebrush areas where the understory is dominated by annual invasive grass or for the treatment of pinyon-juniper encroachment could have site-specific impacts on fuelwood availability for all populations, including those identified for environmental justice consideration. The full suite of treatment actions would occur in Phase I, II, and III Pinyon-Juniper vegetation states. This would increase the potential for short-term impacts from vegetation treatment on fuelwood availability for communities.

In addition, design features for cultural resources (**Appendix D**) would require consultation with potentially affected Tribes prior to treatments (Design Features 23 and 27), in cases where management could affect resources important to traditional lifeways, subsistence, economy, rituals, or religion. This would limit impacts on Tribal communities. Allowing for manual and mechanical methods would provide for a potential long-term reduction in acres burned. Compared with Alternative A, incorporating the full suite of treatments would likely increase restoration effectiveness, resulting in a long-term reduction in the risks from fires for all populations, including populations identified for further environmental justice consideration. In addition, landscape-level restoration and potential fewer acres burned could benefit resources used by environmental justice communities, including wildlife hunted for subsistence use (see **Section 4.7**, Wildlife).

4.13.4 Effects from Alternative C

Under Alternative C, proposed management actions are limited to manual and mechanical treatment. There is some potential for short-term, site-specific impacts. The intensity of these impacts would depend on the site-specific location and treatment being used.

The BLM would limit the types of tools available to only mechanical or manual methods to reduce fuels and restore vegetative desired conditions. Allowing only manual treatment in Phase I Pinyon-Juniper vegetation states and not allowing treatment in Phase II and III Pinyon-Juniper areas could reduce the potential for short-term impacts from vegetation treatment on fuelwood availability.

As discussed under Alternative B, design features requiring consultation with Tribes before treating vegetation could minimize impacts on these populations. Limiting the types of tools available would likely decrease restoration effectiveness. The long-term reduction in the risks from fires to all populations would be the same as described under Alternative B, but to a lesser degree.

4.13.5 Effects from Alternative D

The potential for temporary, site-specific impacts from restoration projects would be focused in 5.7 million acre potential treatment area under Alternative D. Similar to Alternative B, vegetation management, including treatment of pinyon-juniper vegetation, could affect fuelwood availability for environmental justice populations. Design features, as discussed under Alternative B, would mitigate the impacts on Tribal communities.

4.13.6 Cumulative Effects

The cumulative effects analysis area and time frame are the same as described for the cumulative analysis in **Section 4.12**, Social and Economic Impacts. The past, present, and reasonably foreseeable future actions in **Table 4-1** have likely affected and will continue to affect the impacts on social and economic well-being in all project area communities, including environmental justice populations. As discussed in detail in relevant resource sections, historical and current fire suppression, fuels reduction, rangeland restoration, vegetation management activities, and resource management and land use planning have affected and would continue to affect site-specific vegetation conditions and fire risks for local communities. Continued development of roads and ROWs would provide opportunities for community expansion but also represent an increased risk of fire ignition. In addition, natural processes, including the spread of invasive annual grass, and wildland fire would continue to affect the level of fire risk with potential impacts on environmental justice populations and resources important for these communities.

The continued spread of invasive annual grass, drought, and ecological trends for wildfire would result in the same or an increased potential for high-intensity wildfires in the Great Basin in the long term. Should a wildfire occur, impacts could affect populations and resources important for these communities, including those identified for further environmental justice consideration.

In the long term, all action alternatives could contribute to a cumulative reduction in impacts from fire for communities. Treatments would increase the ability to move vegetation toward historical conditions and reduce departure from fire regimes, as compared with Alternative A. Under the action alternatives, the inclusion of design features requiring Tribal consultation before vegetation treatment would minimize impacts on Tribal communities.

Under Alternative B, the proposed vegetation management activities would result in the potential for short-term, site-specific impacts on adjacent communities, including low-income, minority, and Tribal populations. In the long term, treatments would reduce the risks from fires for all populations, including populations identified for further environmental justice consideration. Alternative B would also provide the greatest management flexibility of all alternatives and provide the highest potential for a contribution to the cumulative reduction in fire-related costs.

Under Alternative C, limiting treatment options to manual and mechanical treatments could reduce the effectiveness of fuels reductions and restoration, resulting in a greater potential for wildfire impacts on all communities, including those identified for environmental justice consideration, as compared with other action alternatives.

Alternative D would allow for use of the full suite of tools as discussed under Alternative B. Alternative D would focus treatment in 5.7 million acre potential treatment area; therefore, the potential for short-term, direct impacts from proposed management activities would be focused in these areas.

4.14 Irreversible and Irretrievable Commitments of Resources

A resource commitment is considered irreversible when direct and indirect impacts from its use limit future use options. Irreversible commitments apply primarily to nonrenewable resources, such as cultural resources, and to those resources that are renewable only over long periods of time, such as soil productivity. A resource commitment is considered irretrievable when the use or consumption of the resource is neither renewable nor recoverable for future use. Irretrievable commitment applies to the loss of production, harvest, or natural resources.

There would be some irreversible or irretrievable commitments of resources when implementing the activities proposed under this PEIS. These include:

- Ground disturbance and change that could result in increased erosion over the short term resulting from treatments;
- Short-term impacts to air quality related to treatments;
- Loss, alteration, or change in vegetation where treatments are conducted;
- Loss, alteration, or abandonment of wildlife habitat and travel/migration patterns related to treatments; and
- Potential loss or damage to paleontological or cultural resources during treatments.

4.15 Unavoidable Adverse Impacts

Unavoidable adverse effects may also be expected to occur during treatments. These effects would resemble those described in **Section 4.14,** Irreversible and Irretrievable Commitments of Resources. Many adverse impacts could be lessened by design features but would not be completely eliminated or reduced to negligible levels. Some are short-term impacts, while others may be long-term impacts. These impacts and efforts to mitigate them have been described for each resource in **Sections 4.2** to **4.13**. Depending on the location and extent of projects, unavoidable adverse impacts could potentially include:

- Short term loss of vegetation, short term displacement of wildlife and short term increase in soil erosion.
- Long term loss of soil and site productivity related to surface disturbance and increased erosion over the short term during treatments when restoration treatments are unsuccessful, especially in areas where tilling and other major soil disturbing actions were used;
- Changes in surface flow and drainage patterns due to surface disturbance during treatments;
- Wildlife injury or mortality related to restoration treatment activities;
- Changes in wildlife migration or travel patterns to avoid human disturbance during treatments;

- Potential loss or damage to paleontological and cultural resources related to treatments; and
- Change in the existing visual resource inventory conditions (even if the VRM objectives are met) due to the introduction of any new manmade line, form, color, or texture into an existing landscape.

4.16 Relationship Between Short-Term Uses and Long-Term Productivity

This section compares the potential temporary effects of the actions analyzed in this PEIS on the environment with the potential effects on its long-term productivity. The BLM must consider the degree to which the Proposed Action or alternatives would sacrifice a resource value that might benefit the environment in the long term, for some temporary value to a project proponent or the public.

Specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Design features would be implemented to reduce disturbances and reclaim or improve vegetation cover, soil, and wildlife habitat on affected lands. After the initial treatments are completed, other productive use of these lands would not be precluded in the long term.

Short term and long term impacts are identified in **Chapter 4** above. In general, the vegetation treatments in the short term would temporarily increase erosion, remove vegetation, add to air pollution, and displace wildlife. In the long term, restoration of degraded vegetation communities would reduce erosion, increase plant diversity, increase resistance and resilience of plant communities, improve habitat for wildlife, and shift fire return intervals toward natural levels.

Chapter 5. Consultation and Coordination

Laws and requirements related to consultation and coordination are presented in **Appendix L**.

5.1 Public Involvement and Scoping

5.1.1 Notice of Intent

On December 22, 2017, the BLM published a notice of intent (NOI), titled "Notice of Intent to Prepare Two Great Basin-Wide Programmatic Environmental Impact Statements to Reduce the Threat of Wildfire and Support Rangeland Productivity," in the *Federal Register*. The NOI initiated the public scoping process for the Fuel Breaks PEIS as well as this Fuels Reduction and Rangeland Restoration PEIS. During this period, the BLM sought public comments to determine relevant issues that could influence the scope of the environmental analysis, including alternatives, and guide the process for developing the PEISs. The official comment period ended on March 2, 2018.

In the NOI, the BLM identified the following preliminary issues:

1. Fuel break construction and the associated road improvement for firefighter access could increase human activity in remote areas, introduce noxious and invasive weeds, and increase the incidence of human-caused wildfires.
2. Fuel break construction could remove or alter sagebrush habitat, rendering it unusable for some species.
3. Fuel break construction on either side of existing roads may create movement barriers to small-sized wildlife species by reducing hiding cover.
4. Fuel break construction in highly resistant and resilient habitats may not be necessary because those sites are less likely to burn or will respond favorably to natural regeneration.
5. After habitat restoration treatments, historical uses, such as livestock grazing and recreation, may be temporarily halted until the treatment becomes established and objectives are met.
6. Fuel reduction treatments in pinyon-juniper woodlands could disrupt traditional Tribal use of these sites.
7. The use of nonnative species in fuel breaks could affect listed species and affect species composition in adjacent native plant communities.

The BLM also established a project website with information related to the development of the PEISs https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=186339. The website includes background documents, maps, information on public meetings, and contact information.

5.1.2 Public Scoping Meetings

The BLM hosted 15 public scoping meetings throughout the project area during the public comment period. These scoping meetings were held in an open-house format to encourage participants to discuss concerns and questions with the BLM and other agency representatives. The dates and locations of the open houses are provided in **Appendix L, Table L-1**. Materials presented at the public scoping meetings are available on the project website.

5.1.3 Summary of Public Comments

All written submissions received on or before March 2, 2018, were evaluated and are documented in the scoping summary report, which can be found on the project website. The BLM received 98 unique written submissions during the public scoping period, comprising 1,484 substantive comments. A summary of each of these comments and the BLM's consideration of those comments can be found in the scoping report. There were no unresolved environmental issues or conflicts raised during scoping. A majority of the comments received related to the following:

- The need for implementation of a monitoring program to quantify the effectiveness and maximize the success of fuel breaks
- The need to ensure the recovery of habitat components for species
- The treatment components and treatment areas to include or exclude from the PEIS alternatives in order to develop and maintain fuel breaks and prevent fires
- Evaluation of the direct and indirect costs of the project, including costs of construction, treatments, machinery, and maintenance as well as costs of the impacts on other resources and land uses as a result of proposed actions
- Evaluation of potential adverse impacts on natural, cultural, and socioeconomic resources due to fuels management on BLM-administered lands

5.2 Consultation and Coordination with Agencies and Tribal Governments

5.2.1 Government-to-Government Consultation with Native American Tribes

BLM offices in the six states in the project area sent letters to Tribes inviting them to participate in formal consultation. A list of Tribes who received letters inviting them to participate in formal consultation can be found in **Appendix L**, **Table L-2**.

Of the Tribes contacted, the Burns Paiute Tribe responded stating that it would like to engage in formal consultation. In addition, the BLM is engaged in formal and staff-to-staff consultation with the Shoshone-Paiute Tribes of the Duck Valley Indian Reservation (Sho-Pai) through Wings and Roots meetings, where the Sho-Pai requested continuing consultation as local projects are developed.

5.2.2 National Historic Preservation Act Consultation

The BLM sent letters to California, Idaho, Nevada, Oregon, Utah, and Washington SHPOs in December 2017 initiating consultation per Section 106 of the NHPA and consultation with SHPOs will be ongoing as local projects with the potential to affect historic properties are developed.

5.2.3 Endangered Species Act Consultation

In December 2017, the BLM sent a cooperating agency invitation to the USFWS and notified it of the project. The BLM has worked closely with the USFWS during ESA consultation to obtain feedback on affected species and the effects of the proposed action. The BLM is preparing a biological assessment, and consultation with the USFWS is ongoing.

5.3 Cooperating Agencies

Agencies and Tribal entities that were invited and those who accepted and signed an MOU agreeing to participate as cooperating agencies for this NEPA process are presented in **Appendix L, Table L-3**, Cooperating Agency Participation.

5.4 List of Preparers

This PEIS was prepared by an interdisciplinary team of staff from the BLM and Environmental Management and Planning Solutions, Inc. (EMPSi). **Appendix L, Table L-4**, List of Preparers, provides a list of people that prepared or contributed to the development of this PEIS.

5.5 Recipients of this PEIS

Those cooperators that have accepted invitation will receive a copy of this draft PEIS, along with those Tribes that have accepted the invitation to engage in formal consultation. This PEIS is also available on the BLM's ePlanning website. A copy of this list can be found in the administrative record. Should the list of cooperators change between publication of the draft and final PEIS, an updated list of those who will receive copies of the final PEIS will be included.